No. 64. Vol. 7.
SIXPENCE.
(Registered as a Newspaper.)
FRIDAY, DECEMBER 1, 1905.

PAGE'S WEEKLY

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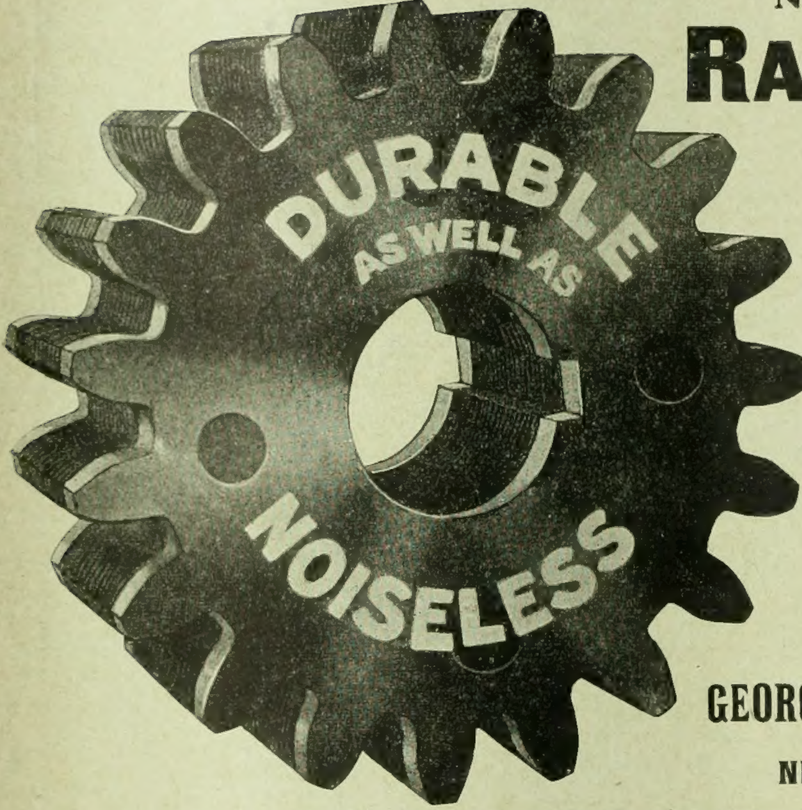

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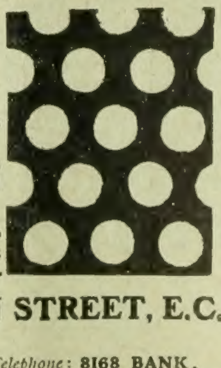

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PAGE'S WEEKLY Miscellaneous

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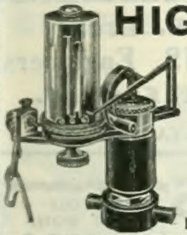
Consulting and Organising Engineer for Water Works and Industrial Undertakings,
19, OLD QUEEN ST., WESTMINSTER, S.W.
Telephone No.: 5754 Bank. Write for particulars.



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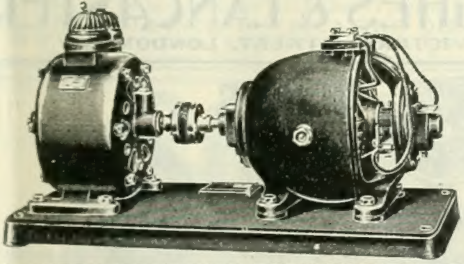
Engineering Instrument Makers

CAST-IRON COLUMNS,
STANCHIONS AND GIRDERS.
Head, Wrightson & Co., Thornaby, Stockton-on-Tees.

The Crypto Electrical Co.,



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COVENTRY, ENG.
Speciality—
FORGING PLANT.
See our Advertisement appearing Dec. 22nd.
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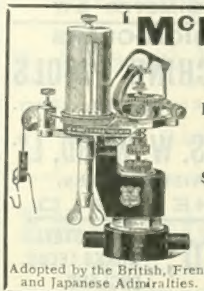
615, WALNUT STREET, PHILADELPHIA, PA., U.S.A.
Rear-Admiral GEORGE W. MELVILLE, Ex-Engineer-in-Chief of the United States Navy, and JOHN H. MACALPINE, having a very extensive acquaintance in the best engineering circles in the United States, Britain, and the Continent of Europe, especially SOLICIT INTERNATIONAL BUSINESS.

DESTRUCTORS and CLINKER MACHINERY.
Horsfall Destructor Co., Ltd., Armley, Leeds.
Telegrams: "DESTRUCTOR." Telephone: 2006.
Codes: A.B.C. (5th Edition) and Leiber's.

A. MOUNT-HAES,
M.I.Mech.E., M.I.M.E.,
Consulting and Mining Engineer for Ore Dressing Plants of All Classes.
11, IRONMONGER LANE, LONDON. E.C.
Tel. Address: "DRESSINGS, LONDON." Telephone No.: 272 Central.



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Special Indicators for Gas, Winding, and Ammonia Engines, and for Motor-Cars.
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These Boilers are in use throughout the world to the extent of 4,700,000 h.p. generating steam for all purposes, and fired with all kinds of fuel.
See our Advertisement appearing Dec. 22nd, page 37.
HEAD OFFICES—Oriel House, Farringdon Street, LONDON, E.C.
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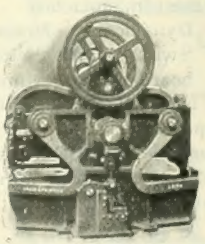

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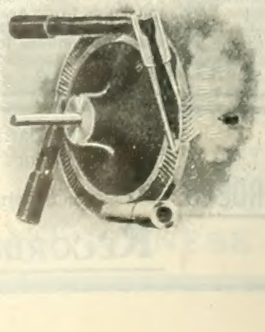

Machine Tools.
Dynamos & Motors.
De Laval's Patent Steam Turbines.

PAGE'S WEEKLY Miscellaneous

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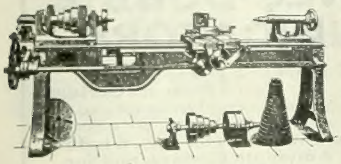

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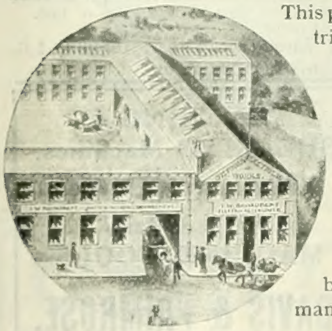

This picture represents an Electrical Engineering Works in Yorkshire, which is specially laid out for the manufacture of Dynamos, Motors, Switches, and Switch boards. Everything is of the best; and prices are the lowest possible, consistent with best material and workmanship.

Note the Name and Address:
T. W. BROADBENT,
Victoria Electrical Works,
EAST PARADE, HUDDERSFIELD.

TRANSPORTERS.
See our Advertisement appearing Dec. 22nd.

TEMPERLEY TRANSPORTER CO.,
72, Bishopsgate Street Within, LONDON, E.C.
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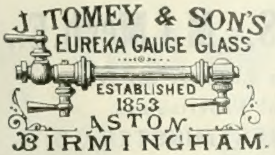

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PAGE'S WEEKLY Miscellaneous

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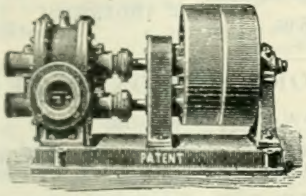

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4,000 Pumps under my System (with a capacity up to 15,000 litres per minute) in use.

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Suitable for BUSHING, NIPPLES, SWITCH HANDLES, and other Insulating Fittings.

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Same odour, same flash point, same result in the working as in genuine Turps. We are the original and only makers of genuine Turpolene.

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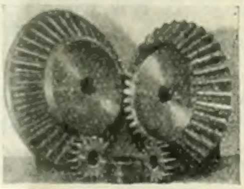

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Also all kinds of Metal Gearing.

AD. AHLERS,
Whitley Bay, Newcastle-on-Tyne.

BERTRAMS, Ltd.,
Sciennes, EDINBURGH.

MACHINE TOOLS.

See Next Week.

EDGAR ALLEN & CO.,
Limited,
Sheffield.

TRAMWAY MATERIAL.

IN ALLEN'S IMPERIAL MANGANESE STEEL.

PAGE'S WEEKLY Contracts

CONTRACTS.

BRISTOL DOCKS.—NEW DOCK WORKS,

AVONMOUTH.

FENDER CHAINS.

The Docks Committee of the City and County of Bristol are prepared to receive **TENDERS** for the **CONSTRUCTION, DELIVERY, ERECTING IN PLACE,** and **MAINTENANCE** for Twelve Months after Erection of **FENDER CHAINS** for the Entrance Lock of the Royal Edward Dock now in course of construction at Avonmouth, in the Port of Bristol.

The contract includes Hydraulic Winding Engines, Relieving Gear, Chains, Capstans, and all details in connection therewith.

On and after November 21st, 1905, copies of the Specification, Schedule of Quantities, Form of Tender, Form of Contract, and Copies of Contract Drawings, can be obtained from the undersigned on production of a receipt from the Secretary of the Docks Committee, showing that a deposit of £5 has been paid in to his office, 19, Queen Square, Bristol.

The deposit will be returned to *bona fide* Tenderers hereafter.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Fender Chains," and addressed to the Secretary of the Docks Committee, Docks Office, 19, Queen Square, Bristol, and must be delivered to him accompanied by the necessary documents before ten a.m. on Thursday, December 7th, 1905.

The Docks Committee of the Council of the City and County of Bristol do not bind themselves to accept the lowest or any Tender.

W. W. SQUIRE,
Engineer.

Engineer's Office, Cumberland Road,
Bristol, November 13th, 1905.

POPLAR UNION.—The Guardians of the

Poor of the Poplar Union are prepared to receive **TENDERS** for the Supply and Erection of the following **PLANT** at the Children's Homes and Schools now in course of erection at Hutton, Essex:—

Section X. STEAM ENGINES, DYNAMOS, PIPEWORK, &c.
" Y. Part 1. MAIN SWITCHBOARD, WIRING, MOTORS, &c.
" " Part 2. FIRE ALARMS, TELEPHONES, and ELECTRIC BELLS.

Persons desirous of tendering may obtain the General Conditions, Specifications, and Schedules, and inspect Plans at the Offices of the Consulting Engineer Mr. ALBION T. SNELL, M Inst.C.E., Suffolk House, 5, Laurence Pountney Hill, Cannon Street, E.C., between the hours of 10 and 4, on and after November 21st, upon depositing in notes or gold the sum of £10 for Section X, and £20 for Section Y, which sum will be returned upon receipt of *bona fide* Tenders.

Contractors will be required to pay all workmen employed the trade union rate of wages, and to observe the hours of labour current in the district.

Sealed Tenders upon the forms supplied, addressed to me, are to be delivered at these offices before six o'clock p.m. on Wednesday, December 13th, 1905, when they will be opened at a meeting of the Guardians.

The Guardians do not bind themselves to accept the lowest or any Tender.

G. HERBERT LOUGH,
Clerk to the Guardians.

Guardian's Offices, 45, Upper North Street,
Poplar, E., November 15th, 1905.

TO ENGINEERS.

WATERWORKS PUMPING PLANT.

THE WIDNES CORPORATION INVITE

TENDERS for the **SUPPLY** and **ERECTION** of a **TRIPLE-EXPANSION ENGINE,** with 20-in. deep Borehole and Force Pumps capable of discharging three million gallons per diem against a total head of 500 ft.

Copies of General Specification, Conditions, and Plans may be had on application to ISAAC CARR, M.Inst.C.E., Widnes, on payment of Two Guineas, which will be returned on receipt of a *bona fide* Tender.

Tenders, addressed to the Chairman of the Water Committee, and endorsed "Pumping Engine," must be delivered at the Town Hall, Widnes, on or before noon on Tuesday, December 5th, 1905.

By order,
H. S. OPPENHEIM,
Town Clerk.

Widnes, November 1st, 1905.

GREAT NORTHERN RAILWAY COMPANY (IRELAND).

The Directors are prepared to receive **TENDERS** for the **SUPPLY** of **SIX STEAM RAIL MOTOR CARS,** in accordance with the Company's Drawings and Specification, copies of which can be obtained on application to the undersigned on payment of One Guinea (not returnable) per set.

Tenders, marked "Tender for Motor Cars," must be lodged with the Secretary not later than 10 a.m. on Monday, December 4th, 1905.

The Directors do not bind themselves to accept the lowest or any Tender.

T. MORRISON,
Secretary.

Secretary's Office, Amiens Street Terminus, Dublin,
November 8th, 1905.

THE SOUTHERN MAHRATTA RAILWAY COMPANY, LIMITED.

The Board of Directors of the Southern Mahratta Railway Company, Limited, are prepared to receive **TENDERS** for

1,000 **STEEL TYRES** for Carriages and Wagons

as per the Specification and Drawing, which may be seen at the offices of the Company.

The charge for the Specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the Secretary, marked "Tender for Steel Tyres," not later than Twelve o'clock noon on Tuesday, December 11th, 1905.

The Directors do not bind themselves to accept the lowest or any Tender.

By order of the Board,
EDW. Z. THORNTON,
Secretary.

46, Queen Anne's Gate, S.W.,
November 22nd, 1905.

HALIFAX CORPORATION WATER-WORKS.

WALSHAW DEAN RESERVOIRS.

CAST-IRON PIPES.

The Corporation of Halifax invite **TENDERS** for the **SUPPLY** of about 415 **TONS** of **CAST-IRON PIPES,** from 24 in. to 12 in. diameter, including irregulars.

Drawings and copies of the Specification, Schedule, and Form of Tender may be obtained on and after Monday, November 27th, 1905, at the offices of Messrs. G. H. HILL AND SONS, Civil Engineers, 3, Victoria Street, Westminster, and Albert Chambers, Albert Square, Manchester, upon deposit of cheque for One Guinea.

This sum will, after the Corporation shall have come to a decision upon the Tenders, but not before, be returned to the tenderer, provided that he shall have sent in a *bona fide* Tender, and shall not have withdrawn the same, and shall have returned the documents lent to him for the purpose of making up his Tender.

Sealed Tenders, endorsed "Tender for Cast-Iron Pipes," must be addressed to the undersigned on or before Monday, December 11th, 1905.

The person whose Tender is accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order,
KEIGHLEY WALTON,
Town Clerk.

Town Hall, Halifax,
November, 1905.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to noon on Tuesday, December 5th, **TENDERS** for the **SUPPLY** of the following **STORES,** viz.:—

(1) DOG SPIKES.
(2) ELECTRIC GENERATORS.
(3) STRAND WIRE FOR FENCING.
(4) SWITCHES.

Tenders must be made on Forms, copies of which, with Specifications, can be obtained at these offices on payment of 21s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

T. W. WOOD,
Secretary.

Offices: Gloucester House,
Bishopsgate Street Without, London, E.C.,
November 23rd, 1905.

THE SOUTH INDIAN RAILWAY COMPANY, LIMITED,

is prepared to receive **TENDERS** for the **SUPPLY** of—

(1) **GENERAL STORES**—comprising hardware, iron, steel, metals, oils and colours, leather and rubber goods, electrical stores, and sundries;
(2) **LOCOMOTIVE STORES**—comprising copper and steel plates, tyres, axles, springs, brass and steel tubes and trollies;
(3) **STATIONERY**—comprising books, paper, envelopes, ink, and sundries;
(4) **IRON WIRE FENCING**—40 tons;
(5) **ROOFING**—5 roofs 100 ft. by 25 ft., 44 tons.

Specifications and Forms of Tender may be obtained at the Company's Offices, on and after Monday, November 27th, 1905.

Tenders, addressed to the Company, and marked "Tender for General Stores," or as the case may be, must be left with the undersigned not later than Twelve o'clock noon of Tuesday, December 12th, 1905.

The Company is not bound to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 20s. for each copy of Specification No. 1, and of 10s. for each copy of Nos. 2, 3, 4, and 5.

Copies of the Drawings may be obtained at the office of Sir GEORGE B. BRUCE, 3, Victoria Street, Westminster, on payment of 5s. per sheet.

By order,
HENRY W. NOTMAN,
Managing Director.

Company's Offices,
55, Gracechurch Street, London, E.C.,
November 24th, 1905.

PAGE'S WEEKLY Contracts and Appointments Open

BOROUGH OF BASINGSTOKE.

WATER SUPPLY—CONTRACT No. 2.

The CORPORATION of Basingstoke invites TENDERS for the SUPPLY, DELIVERY, and ERECTION of SUCTION GAS PLANT, GAS ENGINES, and PUMPING MACHINERY (all in duplicate) in connection with the New Waterworks.

Plans and Specification can be obtained from the Waterworks Engineer on payment of Three Guineas, which will be returned on receipt of a *bona fide* Tender and the return of all documents supplied.

Tenders, on the prescribed form only, endorsed "Pumping Machinery," must be delivered to the undersigned on or before Monday, the 11th December.

The Corporation does not bind itself to accept the lowest or any Tender.

F. REGINALD PHIPPS, Assoc.M.Inst.C.E.,
Waterworks Engineer.

Town Hall, Basingstoke,
November 13th, 1905.

CLYDE NAVIGATION. — TO CRANE, CAPSTAN, and TURNTABLE MAKERS, and ELECTRICAL ENGINEERS.

EQUIPMENT OF CLYDEBANK DOCK.

The Trustees of the Clyde Navigation invite TENDERS for :—

(1) One 20-ton Hand or Electric OVERHEAD TRAVELLING CRANE for the Electric Power Generating Station.

(2) Six Electrically driven QUAY CAPSTANS, and Two Electrically driven Double-geared PIERHEAD CAPSTANS, and

(3) Two Electrically worked TIPPING TURNTABLES.

Copies of the General Specifications and Forms of Tender may be had on application at this office to Mr. GEORGE H. BAXTER, the Mechanical Engineer, on payment of £1 1s. for each Specification, which will be refunded on receipt of a *bona fide* Tender.

Separate sealed Tenders, marked "Tender for 20-Ton Crane," "Tender for Electric Capstans," or "Tender for Electric Tipping Turntables," to be lodged with the undersigned not later than noon on Monday, December 18th.

The Trustees may not accept the lowest or any Tender.

T. R. MACKENZIE,
General Manager and Secretary.

16, Robertson Street, Glasgow,
November 22nd, 1905.

METROPOLITAN BOROUGH OF BERMONDSEY.

The COUNCIL of the above Borough is prepared to receive TENDERS for the SUPPLY and ERECTION of—

Section A—One Water-Tube Marine Boiler.
,, B—One 500-kilowatt Triple-Expansion Steam Dynamo.

Specifications and Form of Tender may be obtained at the Town Hall, Spa Road, S.E., on payment of Two Guineas in cash, which will be returned upon receipt of a *bona fide* Tender. A copy of the Specification may also be inspected at the Office of the Borough Electrical Engineer, Mr. W. E. J. HEENAN, M.I.E.E., Spa Road, S.E.

The Contractor will be required to pay not less than the minimum standard rate of wages for the time being in each trade during the continuance of the Contract, and to pay all labourers a minimum rate of wages of not less than 6d. per hour.

The Council do not bind themselves to accept the lowest or any Tender, and the Contractor whose Tender is accepted shall enter into a formal agreement, under seal, with sufficient sureties, for the due performance of his Contract.

Sealed Tenders, endorsed "Boilers, etc.," must be forwarded to me at or before noon the 8th day of December, 1905.

FREDK. RYALL
Town Clerk.

Town Hall, Spa Road, S.E.

CITY OF LAUNCESTON, TASMANIA.

ELECTRIC LIGHT DEPARTMENT.

TENDERS FOR SUPPLY OF METERS.

The MAYOR and ALDERMEN of the City of Launceston, Tasmania, are prepared to receive TENDERS for the SUPPLY of 500 or more ELECTRIC METERS and for MAXIMUM DEMAND INDICATORS.

Specifications and Conditions of Contract in duplicate may be obtained on application to Mr. WILLIAM CORIN, City Electrical Engineer, Launceston, Tasmania, or to Messrs. JOHN TERRY AND CO., 7, Great Winchester Street, London, E.C., England, on payment of Two Guineas, which sum will be refunded on receipt of a *bona fide* Tender.

Sealed Tenders, endorsed "Tenders for Supply of Electric Meters," must be addressed to the undersigned and lodged in his office not later than 12 o'clock noon of Monday, the 15th day of January, 1906.

C. W. ROCHER,
Town Clerk.

Town Hall, Launceston, Tasmania,
September 25th, 1905.

LYTHAM URBAN DISTRICT COUNCIL.

The GAS COMMITTEE of the above Council are prepared to receive TENDERS for the SUPPLY of 2 or 4 ten-ton RAILWAY COAL WAGONS, each 15ft. 6in. by 7ft. by 4ft. deep inside, with two Side Doors and Strips, etc.

Tenders (together with Specification), stating terms, for net cash or deferred payments, to be delivered at the Office of the undersigned before noon on the 6th December, 1905.

CHAS. A. MYERS,
Clerk to the Council.

November 15th, 1905.

APPOINTMENTS OPEN.

SOUTH AFRICAN COLLEGE, CAPE TOWN.

APPLICATIONS are invited for the Newly founded PROFESSORSHIP OF ELECTRO-TECHNICS in this College.

Age of applicants must not exceed 35 years.

Commencing salary £600 per annum.

Applications, with six copies of testimonials and health certificate, must be sent not later than December 15th, 1905, to the Agent-General for Cape Colony, 100, Victoria Street, London, S.W., from whom further particulars can be obtained.

BIGGLESWADE WATER SUPPLY.

MECHANICAL ENGINEER.

The Joint Committee of the Biggleswade Water Board and the Biggleswade Rural District Council invite APPLICATIONS from persons who have been trained as mechanical engineers for the APPOINTMENT of SUPERINTENDENT of the WATERWORKS.

The person to be appointed must not exceed 35 years of age, and will have to devote the whole of his time to the duties of his office, particulars of which can be obtained from the Clerk to the two Authorities.

Applications, which must give a full statement of the candidate's career, age, and the salary expected, with copies of not more than three testimonials, must be delivered to the said Clerk at his office at Biggleswade, Beds., on or before the 8th December next.

HENRY CHAUNDLER,
Clerk to the Biggleswade Water Board and
the Biggleswade R.D.C.

CITY OF AUCKLAND, NEW ZEALAND.

APPOINTMENT OF CITY ENGINEER.

Applications, accompanied by Testimonials, will be received in the Town Clerk's Office, Auckland, New Zealand, until 4 o'clock p.m. on Thursday, February 8th, 1906, for the appointment of City Engineer to the City of Auckland. Conditions of appointment may be seen, and copies obtained, at the office of the High Commissioner for New Zealand, Westminster Chambers, 13, Victoria Street, London, S.W.

HENRY W. WILSON,
Town Clerk.

September 1st, 1905.

AUCKLAND UNIVERSITY COLLEGE, NEW ZEALAND.

APPLICATIONS are invited for the PROFESSORSHIP of MINING ENGINEERING about to be established at Auckland University College, New Zealand.

Applicants must be qualified to prepare students in the subjects of applied mechanics, mining, and land and mine surveying for the examination of the University of New Zealand required for the degree of Bachelor of Engineering (Mining).

The salary is £500 per annum, in addition to the students' fees, with an engagement for five years. Private practice which did not interfere with the performance of college duties would not be objected to by the College Council.

A suitable allowance will be made for passage money, but not to exceed £100.

The successful applicant must not be over 40 years of age, and must enter upon his duties as soon as possible after January 1st, 1906.

Copies of the questions to be answered by Applicants, the Calendar of the University of New Zealand, and the Form of Agreement to be signed, may be had on application to the High Commissioner for New Zealand, 13, Victoria Street, London, S.W.

THE DIRECTORS OF THE MIDLAND RAILWAY invite APPLICATIONS for the POSITION of SIGNAL SUPERINTENDENT (on the Staff of the Chief Engineer) at a salary of £600 per annum.

Applications, endorsed "Signal Superintendent," must be in the hands of the undersigned not later than 9 a.m. on December 4th.

A. L. CHARLES, Secretary.

Midland Railway, Derby.

BUYERS' DIRECTORY.

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 22 and 24.*

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. for each additional section.

Advertisers' Service Bureau.
British Advertiser Service Bureau, Queen Anne's Chambers Westminster, S.W.

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Band Sawing Machines.
Noble & Lund, Ltd., Felling-on-Tyne.

Bearings (Roller).
Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Belting.
Binney & Son, Catherine Street, City Road, London, E.C.
Cort, Arthur, & Co., Camberwell, London, S.E.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Boiler and Crank Co., Ltd., Grantham.
Hartley & Sugden, Ltd., Halifax.
Thompson, John, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Stirling Boiler Co., Ltd., Motherwell, N.B.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N., 125, Strand, W.C.

Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.

Cables.
Callender's Cable and Construction Co., Ltd.

Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

Castings.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Spottiswoode Advertising Agency, Clun House, Surrey Street, Strand, W.C.
Stafford, Arthur, & Co., Denton, Manchester.

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

Coke Oven Expert.
Mallmann, P. J., 110-118, Victoria Street, S.W.

Condensing Plant.
Benn, Sykes, Haslingden, near Manchester.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

Consulting Engineers.
Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 19 Old Queen Street, Westminster, S.W.
Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A.
Mount-Haes, A., M.I.Mech.E., M.I.M.E., 11, Ironmonger Lane, London, E.C.

Continental Railway Arrangements.
Northern Railway of France.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Copper and Brass.
W. Hepton & Son, Hunslet Lane, Leeds.

Coverings (Boiler).
Magnesia Covering Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham

Destructors.
Heenan & Froude, 4, Chapel Walks, Manchester.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie, Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull

Drilling Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne
Swift, George, Clarence Ironworks, Halifax.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 16, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
British Westinghouse Electric and Manufacturing Co., Ltd., Norfolk Street, Strand, London, W.C.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Ebonestos Manufacturing Co., 22, Rosoman Street, London, E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., Silvertown, London, E.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Scott, E., & Mountain, Ltd., Newcastle-on-Tyne.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co. (*see* Ebonestos Manufacturing Co.), 22, Rosoman Street, Clerkenwell, London, E.C.

Engineers' Supplies.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Engines (Gas).
Campbell Gas Engine Co., Ltd., Halifax.
Cundall, Son & Co., Ltd., Airedale Iron Works, Shipley.

Engines (Electric Lighting).
McLaren, J. and H., Midland Engine Works, Leeds.

Engines (Locomotive).
Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.
McLaren, J. & H., Midland Engine Works, Leeds.

Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Mirrlees Watson Co., Ltd., Glasgow.

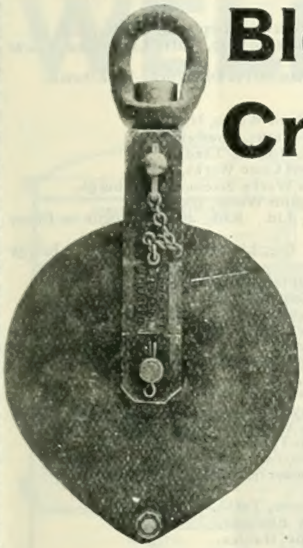
Engines (Traction).
Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.

Engravers.
Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

Exhaust Steam Oil Separators.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Fans, Blowers.
Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.
Gibbs, John & Son, 80, Juke Street, Liverpool.
Matthews & Yates, Ltd., Swinton, Manchester.

Fire Bricks.
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.



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FLEXIBLE & SPECIAL EXTRA FLEXIBLE STEEL WIRE ROPES FOR ALL PURPOSES.

BULLIVANTS' STEEL WIRE ROPE,

ROPE FOR CRANES, LIFTS, DERRICKS, &c.

ONE-THIRD THE WEIGHT

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ABSOLUTELY RELIABLE.

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Contractors
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MINING
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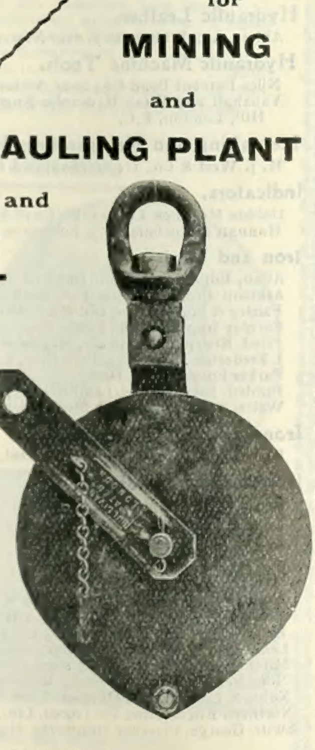
and
AERIAL ROPEWAYS.



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72, MARK LANE, LONDON, ENGLAND.

Buyers' Directory—(*Continued*).

Firewood Machinery.
M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.

Fountain Pens.
Mabie, Todd & Bard, 93, Cheapside, London E.C.

Forging (Drop) Plants.
Brett's Patent Lifter Co., Ltd., Coventry.

Forgings (Drop).
J. H. Williams & Co., Brooklyn, New York, U.S.A.

Furnaces.
Deighton's Patent Flue & Tube Company, Vulcan Works Pepper Road, Leeds.
Leeds Forge Co., Ltd., Leeds.

Gauge Glasses.
J. B. Treasure & Co., Vauxhall Road, Liverpool.
Tomey, J., & Sons, Aston, Birmingham.

Gauges (Pressure, Vacuum, and Hydraulic).
Dobbie, McInnes, Ltd., 45, Bothwell Street, Glasgow.

Gearing.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.
Angus, G. & Co., Ltd., Newcastle-on-Tyne.
Asquith, William, Ltd., Well Road Works, Halifax.
Reid Gear Co., Linwood, near Glasgow.
Wild, M. B., & Co., Corporation Street, Birmingham.

Gold Dredging Plant.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Greases.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Hack Saws.
Baynes, Charles, Knuzden Brook, Blackburn.

Hammers (Steam).
Davis & Primrose, Leith Ironworks, Edinburgh.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hoisting Machinery.
See Conveying Machinery.

Horizontal Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement Pond Co., 23-25, Victoria Street London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Swift, George, Clarence Ironworks, Halifax.

Hydraulic Leather.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Hydraulic Machine Tools.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Vauxhall and West Hydraulic Engineering Co. Ltd., 23, College Hill, London, E.C.

Icemaking and Refrigerating Machinery.
H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.
Dobbie McInnes, Ltd., 45, Bothwell Street, Glasgow.
Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.
Allen, Edgar, & Co. Ltd., Imperial Steel Works, Sheffield.
Askham Bros. & Wilson, Ltd., Sheffield.
Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.
Farnley Iron Co., Ltd., Leeds. England.
Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.
J. Frederick Melling, 14, Park Row, Leeds, England.
Parker Foundry Co., Derby.
Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.
Walter Scott, Ltd., Leeds Steel Works Leeds, England.

Ironwork (Constructional).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Lagging Sheets.
Zeitz & Co., 21, Lime Street, London, E.C.

Lathes.
Asquith, William, Ltd., Well Road Works, Halifax.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Eclipse Tool Manufacturing Co., Linwood, near Glasgow.
Leckenby, Benton, & Co., Perseverance Ironworks Halifax.
Mitchell, D., & Co., Ltd., Parsonage Works. Keighley.
Niles-Bement-Pond Co. 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Clarence Ironworks, Halifax.

Lathe Carriers
Williams, J. H., & Co., Brooklyn New York, U.S.A.

Laundry Machinery.
W. Summerscales & Sons, Ltd., Engineers, Phœnix Foundry, Keighley, England.

Lifts.
Waygood & Co., Ltd., Falmouth Road, London. S.E.

Lubricants.
Blumann & Stern, Ltd., Plough Bridge, Deptford, London S.E.
Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.
Matthew Wells & Co., Hardman Street Oil Works, Manchester.

Machine Tools.
Asquith, William, Ltd., Well Road Works, Halifax.
George Addy & Co., Waverley Works, Sheffield.
Bateman's Machine Tool Co., Hunslet, Leeds.
Beanland, Perkin, & Co., School Close Works, Leeds.
Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).
Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.
Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.
Dean, Smith & Grace, Ltd., Keighley.
Dempster, Moore & Co., Ltd., 49, Robertson Street, Glasgow.
Fengl, A., & Co., Grafton Street, Altrincham.
Greenwood & Batley, Ltd., Leeds.
Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C
John Lang & Sons, Johnstone, near Glasgow.
Luke & Spencer, Ltd., Broadheath, Manchester.
Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund Ltd., Felling-on-Tyne.
Northern Engineering Co., 1900, Ltd., King Cross, near Halifax.
J. Parkinson & Son, Canal Ironworks, Shipley, Yorkshire.
C. Redman & Sons, Halifax.
Resides, 12, Aire Street, Brighouse, Yorks.
Rice & Co. (Leeds), Ltd., Leeds, England.
G. F. Smith, Ltd., South Parade, Halifax.
Swift, George, Clarence Ironworks, Halifax.
Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill Birmingham.
Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.
H. W. Ward & Co., Lionel Street, Birmingham.
T. W. Ward, Albion Works, Sheffield.
West Hydraulic Engineering Co. (see Vauxhall and West Hydraulic Engineering Co. Ltd.), 23, College Hill, London, E.C.
Winn, Charles. & Co., St. Thomas Works, Birmingham.
Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

Marks.
Pryor, Edward, & Son, 68, West Street, Sheffield.

Metals.
Delta Metal Co., Ltd., East Greenwich, London, S.E.
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.
Phosphor Bronze Co., Ltd., Southwark, London, S.E.

Metals (Perforated).
W. Barns & Son, Chalton Street, Euston Road, London, N.W.
Brown, Andrew, & Co., 110, Cannon Street, London, E.C.
Méguin, Fr., & Co., Ltd., Engineering Works, Dillingen-on-Saar.

Mining Machinery.
Fraser & Chalmers, Ltd., 3 London Wall Buildings, London, E.C.

Office Appliances.
Halden & Co., J., 8, Albert Square, Manchester.
Hall & Co., P. J., 39, Victoria Street, London, S.W.
Inglesant, T., & Sons, Ltd., Atlas House, Leicester.
Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.
Rockwell-Wabash Co. Ltd., 69, Milton Street, London, E.C.
Shannon, Ltd., Ropemaker Street, London, E.C.
Trading and Manufacturing Co., Ltd., Temple Bar House, Fleet Street, London, E.C.

Oils, &c.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Wells, M., & Co., Hardman Street Oil Works, Manchester.

Oil Filters and Cabinets.
Valor Co., Ltd., Rocky Lane, Aston Cross, Birmingham.

Packing.
Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.
Lancaster & Tonge, Ltd., Pendleton, Manchester.
Redfern & Co., S., Swan Lane, New Brown Street, Manchester.
Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C
United States Metallic Packing Co., Ltd., Bradford.
J. Bennett von der Heyde, 6, Brown Street, Manchester

Paper.
Lepard & Smiths, Ltd., 29, King Street, Covent Garden, London, W.C.

Patent Agents.
Page & Rowlingson, 28 New Bridge Street, London, E.C.

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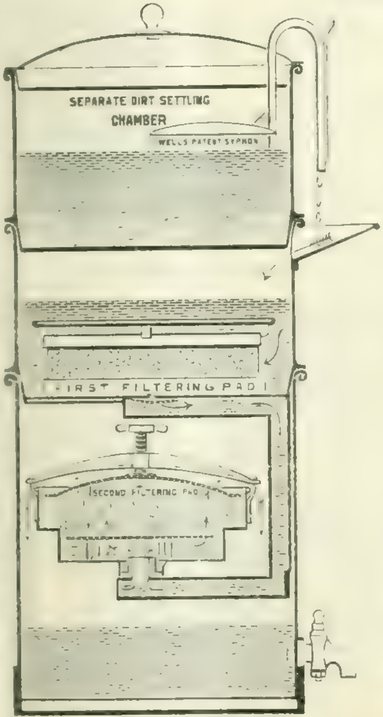
SUPPLIED TO THE PRINCIPAL GOVERNMENTS FOR THE NAVY, DOCKYARDS, &c., AND TO THE LEADING ELECTRIC LIGHT INSTALLATIONS, ENGINEERING WORKS, GAS ENGINE MAKERS, PRINTERS, &c., &c.



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OVER 11,000 SOLD.

MONEY SAVERS to any USERS OF MACHINERY.

Pay first cost in a short time, as Dirtied Oil, which has hitherto been thrown away, can be filtered and used again and again.

Write for List of Testimonials and Samples of Work done by the Filter.

No. 1.—For users having only a small quantity of oil to treat (no syphon) 17 in. by 9 in. ...	35/-
No. 2.—Two top chambers hold about 3 gallons oil, 22 in. by 10 in.	50/-
No. 3.—Two top chambers hold about 6 gallons oil, 27 in. by 12 in. ..	70/-
No. 4.—Two top chambers hold about 12 gallons oil, 36 in. by 16 in. ..	110/-
No. 5.—Two top chambers hold about 24 gallons oil, 43 in. by 23 in.	189/-
No. 6.—Very powerful Filter for treating large quantities of oil, 54 in. by 30 in.	336/-

Capable of dealing with **250** Galls. Oil per week.

LARGER SIZES MADE TO ORDER.

NO OUTSIDE POWER REQUIRED.

LIME, WHITING, OR COLD WATER PAINTS,

Applied at a speed of from 8 to 10 square yards per minute, in a manner superior to brush work.

One coat with the Machine on rough surfaces is equal to two applied with brushes.

Will save First Cost in a Few Days.

No. 6A.	Small size with Detachable Rail	£5 15s.
No. 4.	Price, with 5 ft. Pole, Single Spraying Nozzle, and 20 ft. Special Armoured Hose. Capacity [illegible]	£8 10s.
No. 4A.	Price, with Wheels, 5 ft. Pole, Single Spraying Nozzle, and 20 ft. Special Armoured Hose. **Same capacity as No. 4 Machine.**	£9 10s.
No. 5.	With 5-ft. Pole, Double Spraying Nozzle and 20 ft. Special Armoured Hose, Large Size. Capacity [illegible]	£10 10s.
No. 5A.	Ditto Ditto fitted with Wheels.	£11 15s.

WELLS' IMPROVED LIMEWASH.

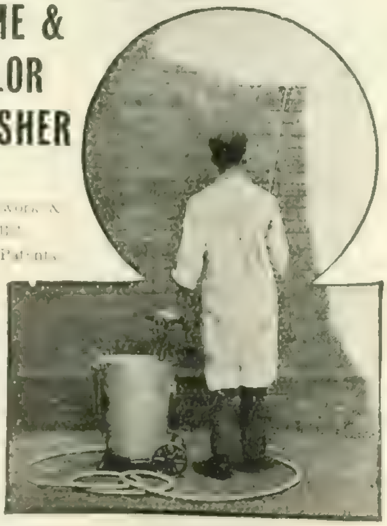
MUCH SUPERIOR TO ORDINARY LIMEWASH. SLAKED WITH WATER QUICKLY MIXED. WILL NOT RUB OFF. LEAVES A GOOD SURFACE

Price 13/8 per cwt.,
Carriage Paid in England and Wales. (If in lots of 3 cwt. at a time, 12/8 per cwt.)

A. C. WELLS & Co.,
100a, Midland Road, St. Pancras,
Works: Cheetham, Manchester. LONDON, N.W.

WELLS' "LIGHTNING" LIME & COLOR WASHER

[illegible] Wells' Patents



No. 4a, with Wheels.

Buyers' Directory—(*Continued*).

Photo Copying Frames.

J. Halden & Co., 8, Albert Square, Manchester.
B. J. Hall & Co., 39, Victoria Street, London, S.W.

Photographic Apparatus.

Marion & Co., Ltd., [illegible] Soho Square, London W.

Pinch Bars.

Samson & Co., Garforth, near Leeds.

Pipe Wrenches (Chain).

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester

Planished Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

Pneumatic Tools.

Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.

Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.

Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pumps and Pumping Machinery.

Drum Engineering Co., 33, Brook Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough.
Hathorn, Davey & Co., Ltd., Leeds, England.
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.

Radial Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds
[illegible] Ltd., [illegible] Works, [illegible]
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
[illegible], Ltd., Felling-on-Tyne
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Clarence Ironworks, Halifax.

Rails.

Wm. Firth, Ltd., Leeds.

Riveted Work.

F. A Keep, Juxon & Co., Forward Works, Barn Street, Birmingham

Roller Bearings.

Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Roofs.

D. Anderson & Son, Ltd., Lagan Felt Works, Belfast
Head, Wrightson & Co., Ltd., Thornaby-on-Tees
[illegible] Newtownards Road, Belfast

Ropeways (Aerial).

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.

Scientific Instruments.

Cambridge Scientific Instrument Co., Ltd. Cambridge.

Slotting Machines.

Swift, George, Clarence Ironworks, Halifax

Spanners.

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stampings.

Thomas Smith & Sons of Saltley, Ltd., Birmingham.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stamps (Rubber).

Rubber Stamp Co., 1 & 2, Holborn Buildings, Broad Street Corner Birmingham.

Stamps (Metal).

Edward Pryor & Son, [illegible] Street, Sheffield.

Steam Traps.

British Steam Specialties, Ltd., Fleet Street, Leicester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.

Thornycroft & Co., Ltd., J. I., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

Steel Tools.

Saml Buckley, St. Paul's Square, Birmingham.
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

Steel Structures.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Stokers.

Ed. Bennis & Co., Ltd., Bolton, Lancs.

Stone Breakers.

S. Pegg & Son, Alexander Street, Leicester.

Superheaters.

A. Bolton & Co., 40, Deansgate, Manchester.

Time Recorders.

Howard Bros., [illegible], Liverpool, and 100b, Queen Victoria Street, London, E.C.
Recorders, Ltd., 171, Queen Victoria Street, London, E.C.

Tubes.

Thomas Piggott & Co., Ltd., Spring Hill, Birmingham.
Tubes, Ltd., Birmingham.

Turbines.

Greenwood & Batley, Albion Works, Leeds.
S. Howes Co., 64, Mark Lane, London, E.C.

Typewriters.

Empire Typewriter Co., 77, Queen Victoria Street, London, E.C.
Yost Typewriter Co., 50, Holborn Viaduct, London, E.C.

Valves.

Holmes & Co., W. C., Huddersfield
Hopkinson, J., & Co., [illegible] Works, Huddersfield
Hunt & Mitton, [illegible] Works, Oozells Street North, Birmingham.
Scotch and Irish Oxygen Co., Ltd., Rosehill Works, Glasgow
Shaw, Joseph, Albert Works, Huddersfield.
Winn, Charles, & Co., St. Thomas Works, Birmingham.

Ventilating Appliances.

Matthews & Yates, Ltd., Swinton, Manchester

Water Softeners and Purifiers.

Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

Wagons—Steam.

Thornycroft & Co., J. I., Ltd., Chiswick, London, W.

Weighing Apparatus.

W. & T. Avery, Ltd., Soho Foundry, Birmingham, England.
Samuel Denison & Son, Hunslet Moor, near Leeds.

Wells Light.

A. C. Wells & Co., 100A, Midland Road, St. Pancras, London, N.W.

Wire Working Machinery.

Ed. Brand, [illegible], Manchester.

"Woodite."

"Woodite" Company, Mitcham, Surrey.

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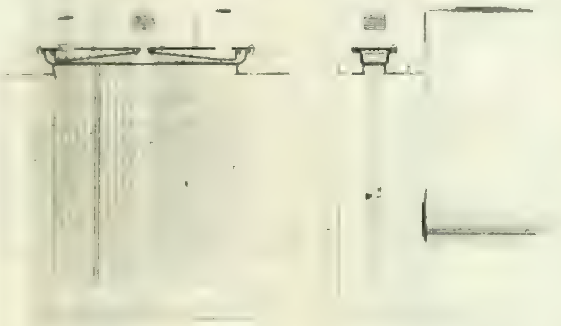
TO STEAM USERS.



OVER 400 WORKING,

Averaging a saving of 15 per cent. of coal and 30 per cent. of water. Repeat Orders coming in.

RELIEVE YOUR BOILERS.

Increase the efficiency of your Engines and improve Production by placing BOLTON'S SUPERHEATER in the Back or Downtake Flue.

To Dry and Superheat the Steam.

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Engineers and Contractors,
49, Deansgate, MANCHESTER.

THE TYPEWRITER FOR BEAUTIFUL WORK.

[illegible] Application

THE YOST TYPEWRITER CO., Ltd.,
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FOR THE BEST BOOKS BEARING ON THE INDUSTRIES DEALT WITH IN "PAGE'S WEEKLY," viz., ENGINEERING, ELECTRICAL, IRON AND STEEL, MINING AND SHIPBUILDING, ASK FOR CATALOGUE. CHARLES GRIFFIN & CO., LTD., 12, EXETER STREET, STRAND, LONDON, AND SEE SPECIAL ADVERTISEMENT ALTERNATE WEEKS.

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Drop forgings
etc.
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OIL SEED AND CAKE MILLS.

GRAB DREDGERS.

Rose, Downs & Thompson, LTD.,
Old Foundry, HULL,
and
12, Mark Lane, LONDON, E.C.

OIL REFINERIES.

WATER SOFTENING PLANT.

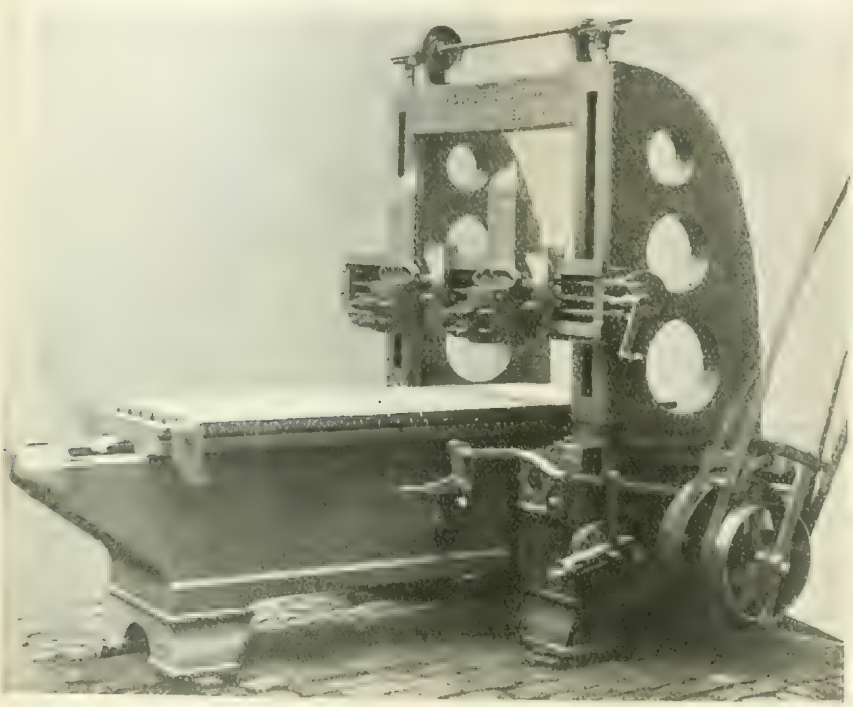
Steam Boilers

(OF ALL TYPES AND POWERS).

Manufactured by

The GRANTHAM BOILER and CRANK CO., Ltd.,
GRANTHAM.

PAGE'S WEEKLY Machine Tools



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MANCHESTER, England.

Telegraphic Address
"Lathe, Manchester."

Showrooms—
**66, VICTORIA ST.,
MANCHESTER.**

Ask for Descriptive Sheet.

PATENT
***Planing . .
Machines.***

SPECIAL FEATURES
Deep Bed, Strong Table,
Unrestricted Belt Angle,
All Gears and Rack Cut,
Absolutely No Shock
when Reversing.

REVISED PRICES.

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PLATE BENDING MACHINE.

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National Telephone No.: 985.

For the Latest and most Up-to-Date

**HEAVY = =
MACHINE
TOOLS = =**

Also Special Lifting Jack for Electric Tramcars.

WRITE . .
**GEORGE ADDY & Co.,
WAVERLEY WORKS, SHEFFIELD.**

**HIGH-CLASS LATHES
& RADIAL DRILLS.**

Write for our Lists.

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"Tools, Keighley."*

D. MITCHELL & CO., Ltd., Parsonage Works,
KEIGHLEY.

On War Office and India Office Lists.

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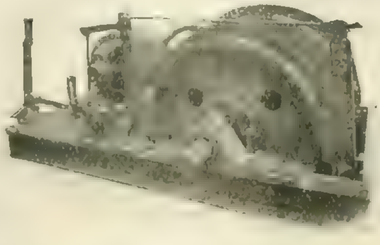

Main and
Tail,
Main Rope,
Endless
Rope,
and
Portable,
Hoisting,
and Hauling
Gears.

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Corporation Street,
BIRMINGHAM.

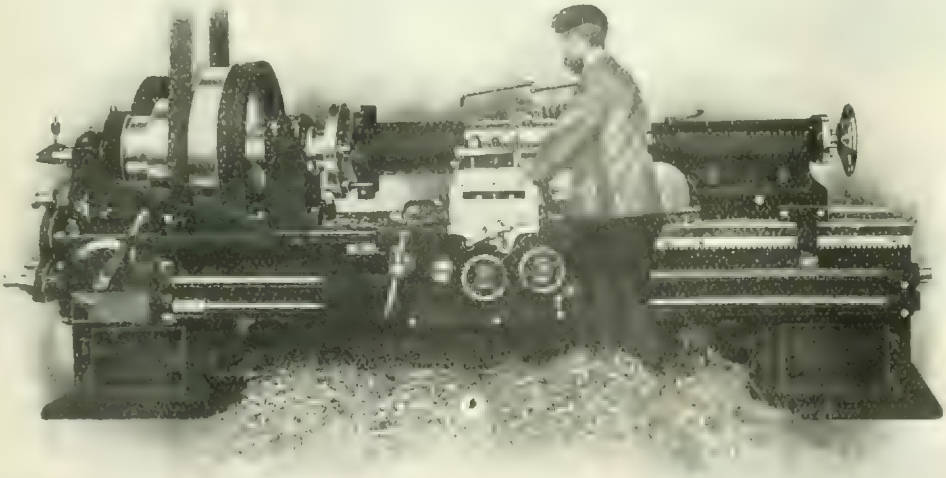
DEAN, SMITH & GRACE, LTD.

KEIGHLEY.

Established 1865.

INDICATIONS POINT TO A VERY BUSY TIME AHEAD.

ARE YOU PREPARED FOR IT?



12-in. High Speed Lathe at work on Steel Forgings at 80 ft. per minute.

If not write at once for our Lathe Catalogue.

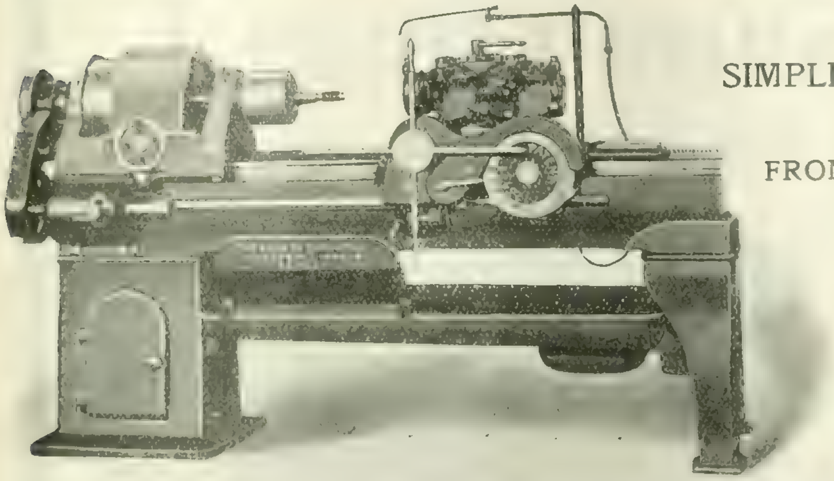
WE CAN PUT YOU ON THE MOST ECONOMICAL FOOTING, AND INCREASE YOUR PRODUCTION.

There is no time like the present. Write now.

Agents for London: BUCK & HICKMAN, Ltd., Whitechapel, E.
Agent for France: LOUIS BESSE, 39, Rue de Lappe, Paris.

PAGE'S WEEKLY **Machine Tools**

TURRET LATHE SPECIALISTS.



Note the
SIMPLICITY of this LATHE.

DIRECT DRIVEN
FROM THE MAIN SHAFT.

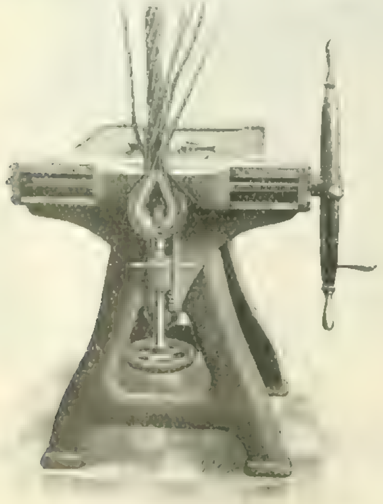
VARIABLE SPEED HEADSTOCK.

The RACK and GUIDE direct under the cutting tool being completely covered.

ALL HANDLES and STOPS within reach of the Operator.
THE ONLY CORRECT GRIP CLUTCH

Telegrams: "CRITERION, LINWOOD."
Telephone: 4Y JOHNSTONE.

ECLIPSE TOOL MFG. CO., Linwood, nr. Glasgow.



Cable Bending and Splicing Vise.

[illegible]

J. PARKINSON & SON,
SHIPLEY, ENGLAND.

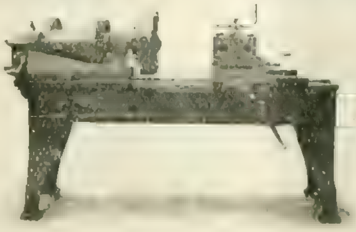
[illegible]

EFFICIENCY
IS THE
KEYNOTE
OF OUR
ESTABLISHMENT

☞ PROVE IT BY A VISIT.

JOHN LANG & SONS,
Johnstone, near GLASGOW

HIGH SPEED LATHES
OUR SPECIALITY.

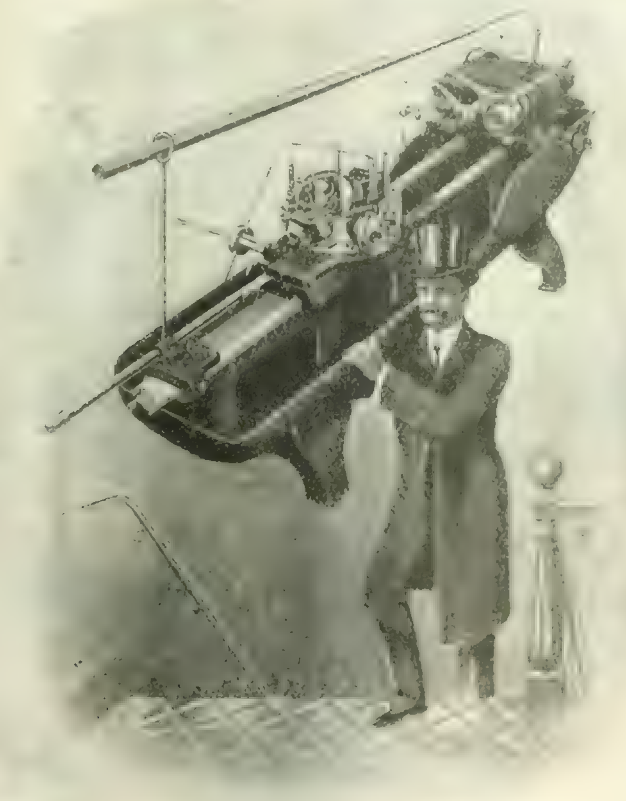


HIGH-GRADE MACHINES
only, in stock for Immediate Delivery.

(Established [illegible].)

C. REDMAN & SONS, Parkinson Lane, HALIFAX.

It would be Impossible



For our Representative to carry a machine on his shoulder

when he comes to interview you regarding the purchase of a Hartness Flat Turret Lathe,

But, if you will call at our premises,

97, Queen Victoria Street, London, one of our expert operators will take very great pleasure in demonstrating to you the merits of our New Model Hartness Flat Turret Lathe, with Cross Sliding Head,

☛ **The only Turret Lathe of the kind on the Market.**

COME AND SEE IT WORKING.

JONES & LAMSON MACHINE CO.,

"Jubilee Buildings," 97, Queen Victoria Street, LONDON, England.

TELEGRAMS: "TURRETORUM, LONDON." [illegible] BANK, LONDON.

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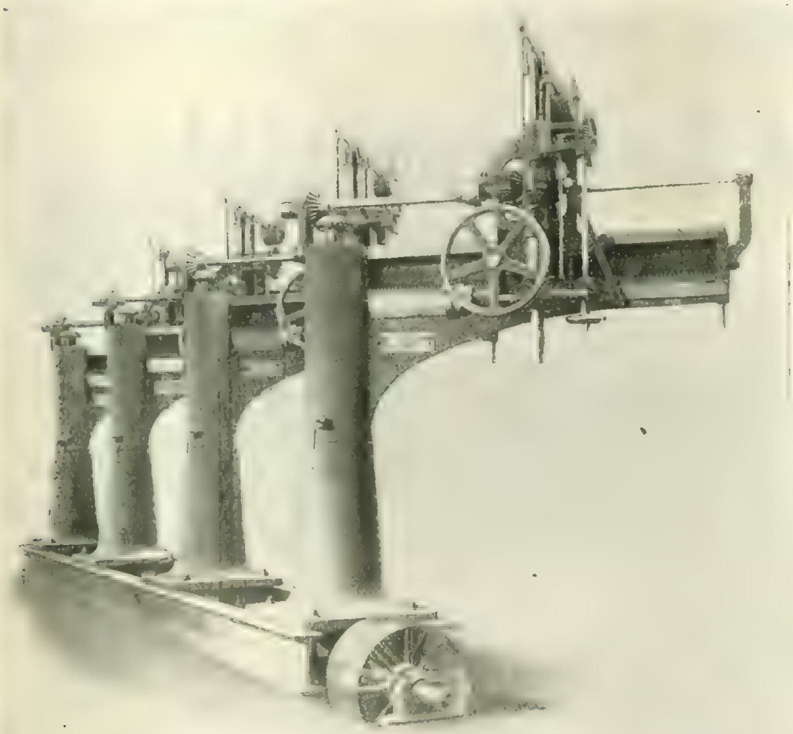

GEORGE SWIFT,
Clarence Ironworks,
HALIFAX.
Telegrams: "SWIFTLY, HALIFAX."
Telephone: No. 497.

RADIAL DRILLING MACHINES
for Constructional Engineers.
A SPECIALITY.

Complete Catalogue on Request.

Contractor to H.M. Government.

Do You Want Any

PRESS TOOLS,
JIGS, CUTTERS,
RIMERS,
GAUGES?

If so, send your requirements, and

A. FENGL & Co.,
ALTRINCHAM,
Will submit design and price.

INVENTORS' MODELS WORKED OUT AND MANUFACTURED.

STAMPINGS TO THE TRADE.

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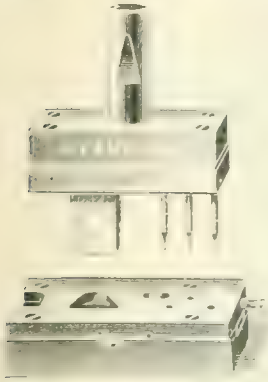
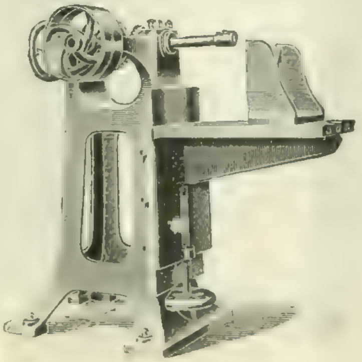




The **JOS. C. NICHOLSON TOOL CO.**
Machine Tool Makers,
NEWCASTLE-ON-TYNE

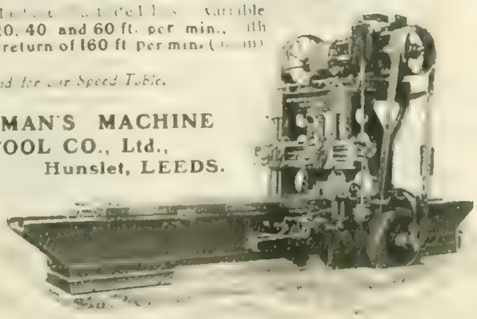
HORIZONTAL
DRILLING MACHINES
[illegible]
Pipe Flanges, Girders,
Angles, [illegible]
Write [illegible]
[illegible]

BATEMAN THREE-SPEED PLANERS

The Machine [illegible] variable cut of 20, 40 and 60 ft. per min., [illegible] return of 160 ft per min. [illegible]

Send for our Speed Table.

BATEMAN'S MACHINE
TOOL CO., Ltd.,
Hunslet, LEEDS.



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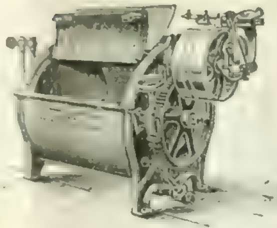
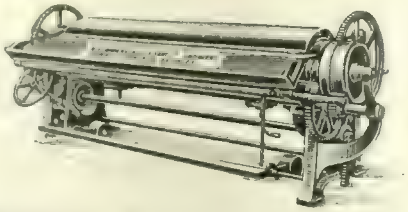
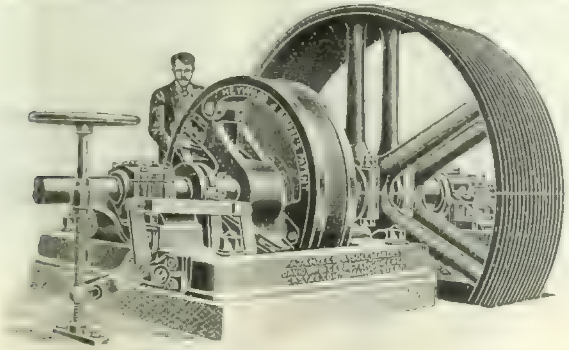


LAUNDRY
MACHINERY
and Steam COOKING APPARATUS.

Please write for our New Catalogue, **N.**

Summerscales, Ltd., KEIGHLEY, ENGLAND.





HEYWOOD & BRIDGE'S
Patent Friction Clutches.
AND COMPLETE
Hauling and Gearing Installations.
The Ideal Clutch for Gas and Oil Engines.

Illustration Shows Friction Clutch Drive in connection with a [illegible] B.H.P. Engine.

SEND FOR 200-PAGE WORK, FREE.

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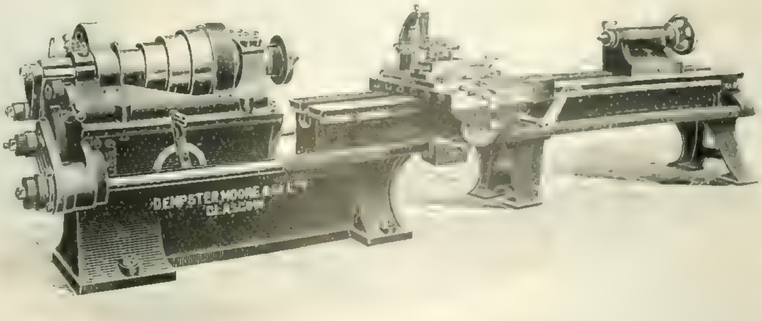
Dempster, Moore & Co., Limited,
ENGINEERS, GLASGOW.

Modern Machine Tools of all Kinds.

SPECIALITY—LATHES FOR HIGH-SPEED CUTTING.



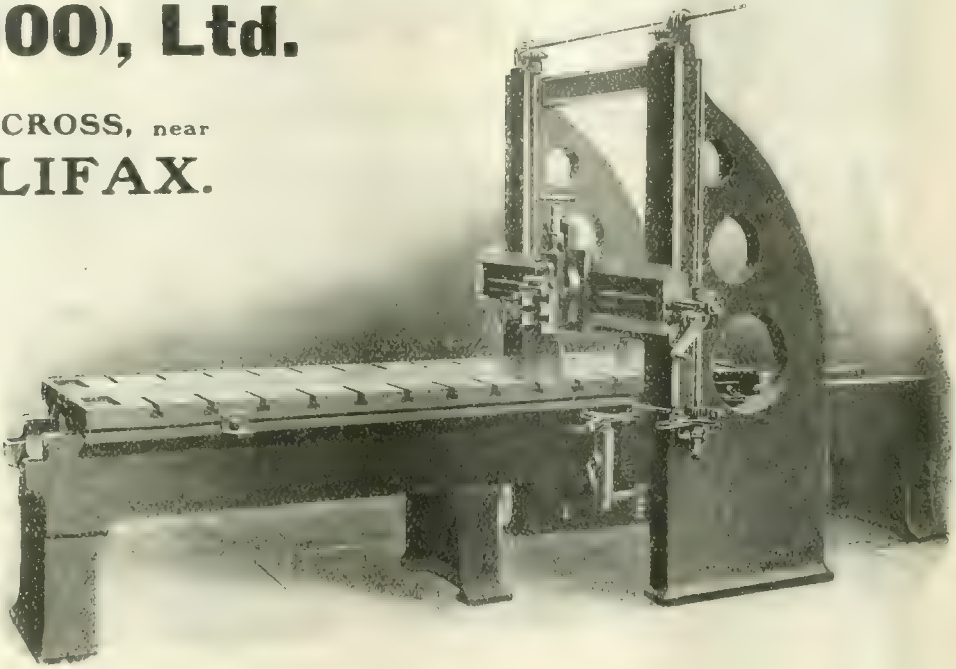
From a Photograph of a 9 inch High-Speed Lathe.

C

PAGE'S WEEKLY. Machine Tools

Northern Engineering Co. (1900), Ltd.

KING CROSS, near
HALIFAX.



PLANING
MACHINE,
from 2 feet
up to 8 feet
square.

BRADBURY'S

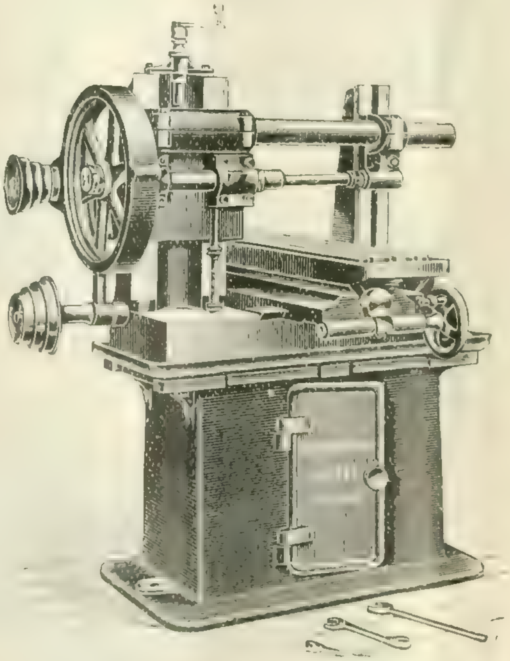
Newly Designed

Standard Milling Machine

For

SPEED,
ACCURACY,
ADAPTABILITY,

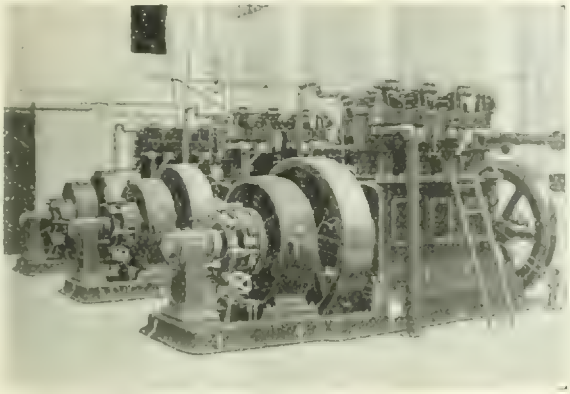
IS **A 1.**



Prices and Particulars from - -

BRADBURY & Co., Ltd., Wellington Works, OLDHAM.

Westinghouse Gas Engines



[illegible] B.H.P. Westinghouse [illegible] Engines [illegible] U.D.C. An example [illegible] Supply Station [illegible].

are

Vertical, Multicylinder, and Enclosed, and may be operated with either Illuminating, Producer, Blast-Furnace, or Coke-Oven Gas.

Suitable for all classes of Service. Particularly adapted for parallel running with alternators.

Perfect Speed Regulation.

The British Westinghouse Electric & Manufacturing Co., Ltd.,
LONDON. **Branch Offices in all Large Towns.** **MANCHESTER.**

ROOFS

MAXIMUM of AREA covered at a MINIMUM of COST.

FOR
Shipbuilders,
Tanners,
Iron Founders,
Ropewalks,
Electricians,
Collieries,
&c., &c.

NEAT & STRONG.

Can be made up to 100 ft. span WITHOUT CENTRE SUPPORTS.

Sites Inspected.

Estimates given to any Plan and Specification.

McTEAR & CO., LTD.,

ROOF CONTRACTORS

&c

[illegible] "M'Tear, Belfast" **BELFAST, Ireland.** [illegible]

ON ADMIRALTY AND WAR OFFICE LISTS.

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John I. THORNYCROFT & CO., LTD.

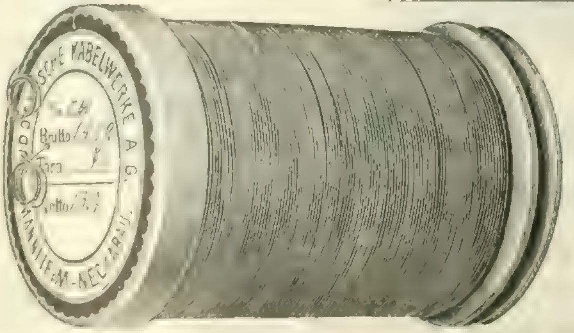
Makers of . . All Types of **Steam and Petrol Vehicles.**

WORKS: CHISWICK, SOUTHAMPTON, BASINGSTOKE. MOTOR VEHICLE DEPT: HOGARTH LANE, CHISWICK, W.

SÜDDEUTSCHE KABELWERKE A.-G., Mannheim,

(SYSTEM BERTHOUD BOREL.) GERMANY.

Contractors to the Imperial German Postal Authorities.



Silk-Covered Copper Wires.

TELEPHONE CABLES.
With Paper and Air Insulation.

LEAD-COVERED CABLES
For all Tensions up to 40,000 volts.

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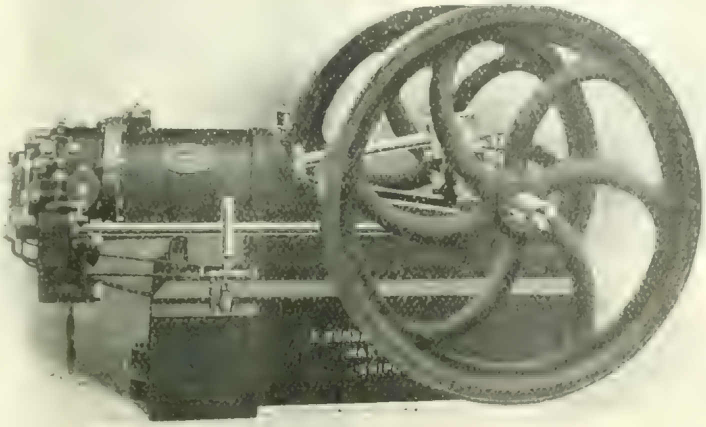
THE "CUNDALL" PATENT **OIL ENGINE,**

THE MOST POPULAR OIL ENGINE.



In use in all Countries.

CUNDALL'S NEW SUCTION GAS ENGINE and GAS PRODUCER PLANT.

50 h.p. costs under 5d. per hour. Larger and smaller engines at the same rate, sizes 10 to 300 h.p.

CUNDALL, SONS, & CO., Ltd.,
SHIPLEY, YORKS.
Telegrams: "CUNDALL, SHIPLEY." Telephone No.: 4 SHIPLEY.

Offices and Showrooms:
LONDON:
20 & 22, St. Bride Street,
E.C.

SOMETHING NEW.

How to deal with Inward Invoices.

Does your present system involve the looking through a mass of detail before arriving at any required invoice?

If it does, then you are wasting your time.

YOU CANNOT AFFORD TO DO THIS.

THINK OF THE SAVING

if you adopt a system that will enable you to find any required invoice at once.

YOU OUGHT TO KNOW SOMETHING ABOUT THIS.

PARTICULARS OF

The Trading & Manufacturing Co., Ltd.,
C.I. DEPT.,
27 & 28, FLEET STREET, LONDON, E.C.

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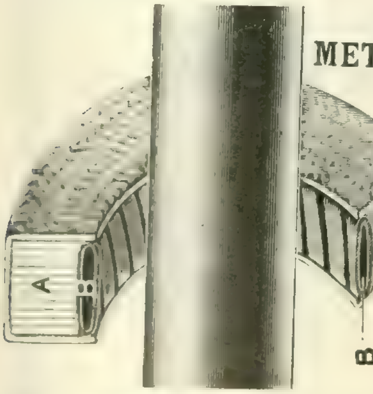

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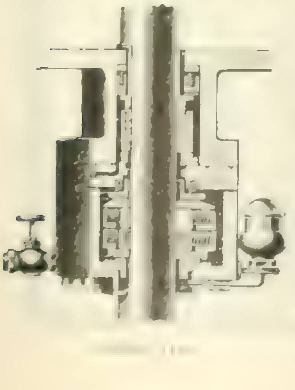

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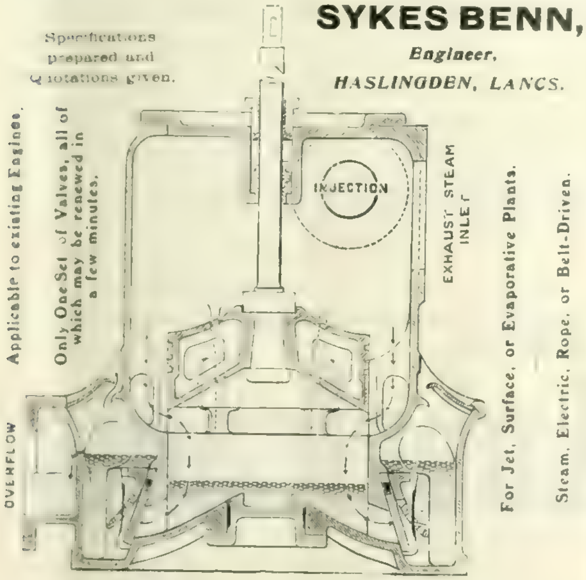

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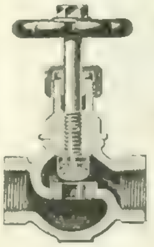

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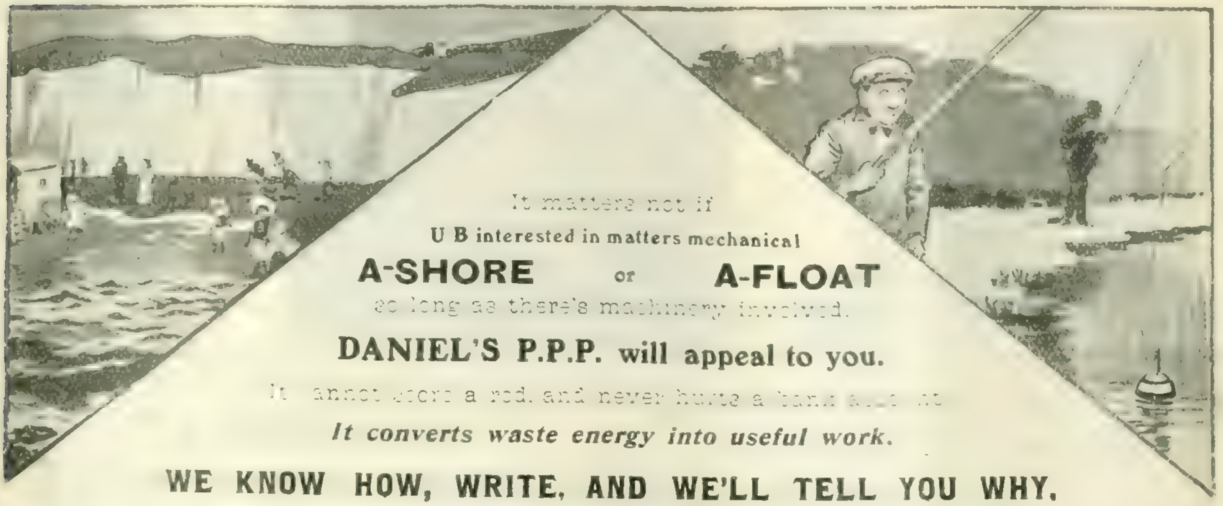

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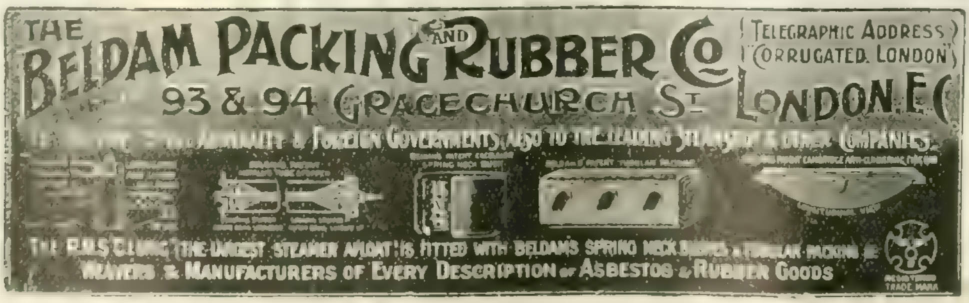

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PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VII. LONDON, FRIDAY, DECEMBER 1, 1905. No. 64.

The Offices of "Page's Weekly,"
Wednesday Evening.

A CORRESPONDENT of the Glasgow Herald states that most of the constructive material and the locomotives for the new railway across the desert from the Red Sea to the Nile at Suakim have been sent from Glasgow, and the work is now so far advanced that the line will be opened in a month or six weeks hence. The line extends from Suakim, the present sea terminus, 332 miles into the interior, traversing first northward, and then ascending the plateau, 3,000 ft. high, which runs parallel with the coast. Stretching fifty miles across the waterless waste of the desert, it reaches the Atbara River twenty miles below its confluence with the Nile. Skirting the river it ultimately joins the Khartoum-Wady-Halfa Railway north of the Atbara Bridge. The cost of the new line is over two millions. There are extensive bridge works, and for these Sir William Arrol and Co., Ltd., of Glasgow, have sent out fifty-one spans of 105 ft.—a very heavy piece of standardised work—while the Glasgow locomotive works, presided over by Mr. Reid, have sent well designed engines. Suakim, adds the correspondent, may cease to be a great port, as the new terminus now known as Port Soudan, 45 miles north of Suakim, has already greatly developed, and has a population of [illegible]000. The country traversed is capable of great development; but what is of still greater moment is that the line will greatly reduce the present price of £4 per ton for fuel at Khartoum, and will thus stimulate the mechanical industries.

[illegible] ROBINSON, M.INST.C.E.,
Chief Mechanical Engineer of the Great Central Railway.
(See page [illegible].)

The Olympia Motor Show, with its numerous omnibus exhibits, has again raised the motor-bus and electric car controversy. In spite of the comparisons made between the motor omnibus and the electric car, often to the disadvantage of the former, the demand for motor omnibuses is such as to be absolutely beyond the output of those at present engaged in the business demand. It is in this particular class of motor vehicle that great developments are to be expected. The motor omnibus has now been in operation long enough to enable its working costs to be quite accurately compared with those of the electric car. The estimate put forward some time since was 10d. per mile, and in actual practice 9½d. is stated to be the actual figure. A good deal, however, depends on the nature of the route over which the omnibus runs. It is clear however, that the motor bus has come to stay.

Mr. J. M. Gledhill's continuation of the story of high-speed steel last week included some very interesting illustrations of its application to machine tools, though of course they by no means covered the whole of the ground. As Mr. Gledhill remarked at the close of his paper: "Other applications of high-speed steel are of a varied and extensive character, embracing many fields of industry, ranging from machining slate and marble, and to razors for shaving, thus making it possible for those whose time is limited to indulge even in high-speed shaving. The Iron Age, comments on the fact that with the advent of high-speed steels the standard types of machine tools had remained practically unchanged for years.

The changes that followed, says our contemporary, were mainly modifications, such as increasing the proportions of parts and providing greater power. One innovation, which was principally an outcome of the availability of tools of higher capacity, was the introduction of mechanical change-gear devices for variable-speed drive. The last two years have seen the bringing out of many forms of such devices. With these exceptions, there have been no radically new features in the universal machine tools, by which are meant engine lathes, planers, milling machines and drills. This in spite of the fact that there was never more talent devoted to the development of the machine tool design than at present. The inference is plain; these tools have so nearly reached perfection, that there is little left to be desired along their lines, and naturally effort may be more profitably directed toward the producing of special tools for which a demand now exists. The notable tendency of modern machine shop practice is toward the more extended use of what are known as "single purpose" machines, or machines specially designed for single operations. Their range of work is necessarily limited, but this is a sacrifice of little account in comparison with the advantage of greatly increased producing capacity.

Mr. Arthur Dickinson, A.R.S.M., M.Inst.M.M., contributes to the Bulletin of the Institute of Mining and Metallurgy a brief account of a mining trip to Norway. The Brustad Mine, with which he was chiefly concerned, is situated in the Eidsvold district, some fifty miles north of Christiania, and eighteen kilometres east of the main line from Christiania to Trondhjem. The Brustad Mine, it appears, was first worked as a copper mine some one hundred years ago. Experiments lately made have shown that gold occurs to a large extent in the free state. The plant for the treatment of the ore was erected by Messrs. Fraser and Chalmers, and consists of fifteen head of stamps, with three Frue vanners and a Wilfley, besides an Elmore oil concentrating plant for the treatment of the tailings. "On my arrival in 1899," says Mr. Dickinson, I "found a small gold boom at its height, and half the population engaged in taking up claims, many scouring the woods at night with lanterns in the hope of finding a speck or two of pyrites, which would be quite sufficient to constitute and be forthwith termed a mine."

"There is no country," he continues, "where the prospector, who is anything from a tailor to a farmer, is more sublimely ignorant of the value of minerals than in Norway. This ignorance, which is often allied to a boundless faith, has, I believe, done not a little to bring discredit on the mining possibilities of the country. Otherwise I have the highest opinion of Norwegians. They make very capable miners, and are most reliable. The Mining Laws are liberal, and, although in need of revision on many points, they have so far worked well; how far they would bear the strain of a "rush" is open to doubt. The fact that a claim has only one absolute defining point might, I think, lead to a good deal of litigation. Any Norwegian subject is at liberty to take up claims on another man's property, but only in the "udmark," i.e., the woodland or uncultivated land; the owner retaining one-tenth interest in the claim."

"This arrangement works well in practice, but as the owner is allowed thirteen months in all to come to a decision as to whether he will take up his share, or sell it by auction or otherwise, one can imagine that, in certain cases, considerable delay might result. Recently a law has been passed, by which no foreigners may own land in Norway or take up mining claims; this restriction is, however, of little importance, and encouragement is given to the much-needed foreign capitalist. Mining costs in Norway are low; labour is plentiful and cheap, and in most districts water power is available. Cord-wood, which, roughly speaking, costs only half as much as coal, is plentiful, and in many districts considerable reductions can be effected by the use of peat, which has proved, when properly cut, pressed and dried, to be a very valuable fuel. Living in Norway is cheap and good, says Mr. Dickinson in conclusion. The people are extremely hospitable, and the climate unsurpassed."

At a meeting of the Sheffield Society of Engineers and Metallurgists, Mr. J. E. Stead, F.R.S., lecturing recently on "The Behaviour of Phosphides and Carbides when together in Iron," described the many existing methods by which the portions of iron or steel, high in phosphorus, can be identified. He also quoted results confirming Professor Arnold's and Mr. McWilliam's observation that solid phosphide of iron diffuses into solid iron and steel at elevated temperatures. The micro-structure and mechanical properties of a series of steels were described; and Mr. Stead explained what occurred when steel solidified in the ingot mould, and clearly proved the existence of three distinct modes of segregation: (1) The microscopic, in the body of the crystal itself; (2) The minor segregations, which were entangled at the junctions of the crystallites; and (3) The major or axial segregation, well known to all steel makers.

Interest of a painful character has been excited by the announcement that an American electrician has invented an electric "spanking" machine. It is understood that the apparatus is at present only in the experimental stage, no "figures" being yet available. Tests are however, to be made shortly and the statistical information, which will doubtless be forthcoming, is awaited, in journalistic and electrical circles, with impatience. The machine promises to be a beautiful illustration of the application of science to the daily needs of the rising generation. The punishment can now be nicely adjusted to fit the crime.

At the [illegible] meeting of the Tramways and Light Railways Association, Mr. James Devonshire, the chairman, raised anew the grievance of the electric tramway companies, who, while only using the rail, are not only rated in respect of their ownership of the track on which the cars run, but have to maintain the road for the benefit of other descriptions of traffic. It is only natural that tramway engineers should lay a paving which is cheap both in first cost and maintenance. Granite appears to be the favourite material, as, although the first cost of granite paving is heavier than wood, the expense of maintenance is less. In connection with road foundations, wrought iron has hitherto been mainly used in conjunction with concrete in order to compensate for the low tensile strength of concrete, but expanded metal is now being experimented with what is stated to be very remarkable results. A new method of armouring macadam roads which has been well spoken of by engineers, has been adopted with much success in Germany. In this process layers of equal sized stones are used, the sizes generally used being 3½ in. by 4 in. and 4 in. to 4½ in. in depth. The result is said to produce a mosaic-like covering of extraordinary durability, while the road is claimed to be dustless and to give reduced resistance to traction. The cost too is said to be very low, something like 5s. per superficial metre. Those interested in the proposed motor roadways will please note.

A curious engineering feat is described in the American technical press which incidentally illustrates the adaptability of concrete work to peculiar and difficult situations. In the rapids above Niagara Falls, Canadian side, the commissioners of Victoria Park have built a wing dam, to increase the depth of water in the intake of the large power plant. The dam is built of concrete, and in order to place the material in the swift water the commissioners followed a suggestion of Mr. Isham R[illegible] [illegible]cago consulting [illegible] of the Chicago drainage canal. According to Mr. Randolph's plan, the dam was built as a column 50 ft. high and 8 ft. square, standing on a wooden trestle 20 ft. high. This column was built in six sections, with a heavy steel chain running through the centre, to hold them in line after the column should fall. On the stream side wedges were inserted at the section divisions to cause the column to break up when striking the rock bed of the stream. The column was tipped over by jacking under one side of the trestle. It fell in the desired location and caused the water in the intake to rise 10½ in.

Mr. J. G. Robinson, chief mechanical engineer of the Great Central Railway Company, whose portrait appears on page 1191, was educated at Chester, and served his apprenticeship at Swindon, under the late Mr. Joseph Armstrong, who, at that time, was head of the Great Western mechanical engineering department. Upon the expiry of his term of apprenticeship he was engaged by the same company at Bristol, principally in connection with their running department. Having gained a varied experience on this line, in 1884 he joined the staff of the Waterford, Limerick and Western Railway of Ireland as assistant superintendent of the locomotive, carriage and wagon departments. He was subsequently appointed head of these departments, a position held by Mr. Robinson for twelve years. In June, 1900, he severed his connection with the Irish line in order to take up the position of locomotive engineer to the Great Central Railway. About two years later, in addition to the locomotive department, the directors placed under his charge the carriage and wagon departments, and designated him chief mechanical engineer to the company. Mr. Robinson is a member of the Institutions of Civil Engineers, Mechanical Engineers, and the Association of Railway Locomotive Engineers.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

Clun House, Surrey Street, Strand, London, W.C.

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MEETINGS, ETC., FOR THE ENSUING WEEK.

FRIDAY, DEC. 1.—Institution of Civil Engineers (Students' Section), Great George Street, Westminster, S.W.: Paper, "An Installation for the Bacterial Treatment of Sewage at Neath," by W. J. Jenkin, 8 p.m.

SATURDAY, DEC. 2.—Glasgow Technical College Scientific Society: Paper, "Metallography," by James Muir.

MONDAY, DEC. 4.—Institute of Marine Engineers, Romford Road, Stratford, 8 p.m.—Society of Chemical Industry, [illegible] House, 8 p.m.—Society of Engineers at Royal United Service Institution, 7.30 p.m.: Paper, "The Grindleford Stone Quarries and their Working," by Mr. Benjamin L. Bradley.

TUESDAY, DEC. 5.—Institution of Civil Engineers, [illegible] George's Street, S.W., 8 p.m.

WEDNESDAY, DEC. 6.—Geological Society of London: Mr. Bennett H. Brough lectures at Memorial Hall, Farringdon Street, on "Mining in Ancient and Modern Times."

THURSDAY, DEC. 7.—Royal Society, Burlington House, 4.30 p.m.—Civil and Mechanical Engineers' Society: Paper, Dr. J. S. Owen, on "Concrete Mixers," Caxton Hall, Westminster, 8 p.m.—Institution of Electrical Engineers, Great George Street, S.W., 8 p.m.: Paper, "The Charing Cross Company's City of London Works," by Mr. W. H. Patchell.

FRIDAY, DEC. 8.—Physical Society, Royal College of Science, [illegible].

NEWS ITEMS.

A new railway is proposed from the High Peak of Buxton through Matlock, to Clay Cross, Heath, and Bolsover, thus opening up direct communication with a hitherto untapped area of the Derbyshire coalfield. The works would include a viaduct over Matlock Valley and the boring of a tunnel, a mile in length, near Tansley. The cost of the line is estimated at £900,000.

The new harbour works at Famagusta, Cyprus, are now practically complete, the works including a large outer harbour, with 4½ to seven fathoms of water, an approach channel, an inner harbour, 900 ft. long, [illegible] and [illegible] ft. deep, and an additional basin at the southern end of the inner harbour, 450 ft. [illegible] ft. wide and [illegible] ft. deep.

Some important reductions are announced by the District Railway Company, to come into operation on December 1st, in the single journey fares over the Inner Circle portion of their system. In no case will the fares on this portion of their system be in excess of 4d. first class and 2d. third class single.

The [illegible] and Estates Committee of the Johannesburg Town Council has submitted a lengthy report regarding the site for the International Exhibition which it is proposed to hold at Johannesburg in 1907, and recommend the granting of Milner Park for the purpose.

The Naval Board of Construction at Washington has decided adversely on the recommendation by the General Board for the construction of battleships of 18,000 tons, declaring its preference for battleships of 16,000 tons.

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The S.S. Carmania.

The *Carmania*, the largest turbine-driven steamship in the world, built for the Cunard Company by Messrs. John Brown and Co., Clydebank, arrived in the Mersey on the 22nd ult., after completing severe steam trials. The vessel, which is from the same designs as the *Caronia*, with, however, turbines instead of reciprocating engines, is 678 ft. long and 72½ ft. broad. Her displacement is 39,830 tons, and her gross tonnage 20,000; and at her loaded draught of 32 ft. she is designed to carry 12,000 tons deadweight. Her complement of passengers and crew is 3,100—300 first-class passengers, 350 second class, 1,000 third class, 1,000 steerage, and 450 officers and men. The notable feature of the ship is her turbine machinery, which drives triple propellers, one on each line of shafting, a high-pressure turbine driving the centre, and a combined low-pressure and a stern turbine the two side lines of shafting. Owing to the large power developed and the consequent unusual size of the turbine casing, special arrangements had to be made to prevent distortion and allow for expansion. The turbines, on account of having to run at such a relatively low number of revolutions—185 to 190 per minute—have casings four times the size of anything yet constructed, the low-pressure casings are 14 ft. outside diameter, and 36 ft. long. During the trials she maintained with about 188 revolutions an average speed of somewhat over 19 knots.

Steel Plates for Japan.

In the King's Bench Division, London, Mr. Justice Channell gave judgment in a claim made by John Birch and Company against Lloyd's Registry of British and Foreign Shipping for the alleged negligence of their surveyors in regard to the testing of certain steel plates made in Germany, and sold to the Japanese Admiralty. Messrs. Birch alleged that Lloyd's, by their surveyors' negligence, allowed themselves to be defrauded by German workmen in the testing of the plates, and the result was that the Japanese Admiralty refused the plates as of inferior quality. Evidence having been given, his Lordship said the case must be decided on the state of knowledge at the time the [illegible] inspected. It was always formerly understood that an expert surveyor could detect when a plate had been tampered with, but now it had been discovered that tampering could be done so cleverly that it was impossible for the expert to discover if a plate had been tampered with. Under these circumstances he gave judgment in favour of Lloyd's.

A Double Pelton Wheel at Work in Spanish Mines.

The accompanying illustrations show a double Pelton wheel, made by Messrs. Carrick and Ritchie, of Edinburgh consisting of two wheels 3 ft. in diameter, fitted to a steel shaft and completely enclosed in a steel casing. The water is directed on to each wheel through two nozzles fitted at suitable angles, so as to direct the water into the buckets of the wheel to the best advantage. The arrangement of these nozzles is clearly shown in fig. 1.

The water from the main pipe, which is 18 in. in diameter, passes through a sluice valve, and then into a special casting, forming the end of the casing which encloses the wheel. This casting is provided with four short branch pipes, to which the nozzles are fitted. Each nozzle casting is made of hard bronze, and is fitted with movable tongues. When fully open, the mouth of the nozzle is 2 in. square in cross section, but according to the power required, the outer ends of the two tongues are caused to approach each other and reduce the area in proportion to the load. This arrangement maintains the centre line of the jet in the correct position to produce the best results and the full pressure is maintained at the point of discharge.

The opening and closing of the tongues is effected by means of levers and rods, as shown, and they may be operated either by hand or by governor. The hand gear consists of a quadrant fitted to the horizontal shaft operating the nozzles. A worm mounted on a swivelling bracket and fitted with a hand wheel gears with the worm, this being used to start up the plants.

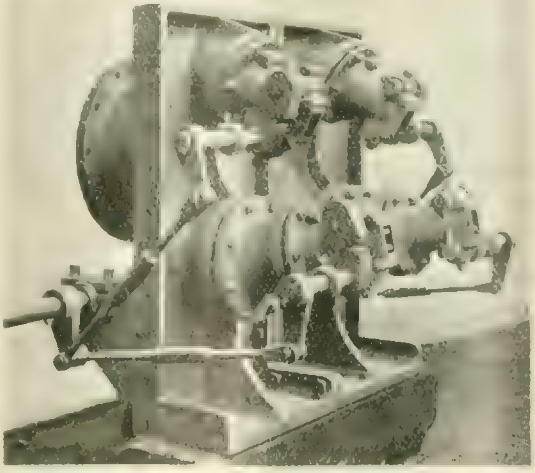


FIG. 1. [illegible] NOZZLES FOR DOUBLE PELTON WHEEL.

After the proper speed is attained, the worm is disconnected from the quadrant, and the governor put into operation.

The governing arrangement consists of an ordinary Pickering governor, driven by double belts direct from the Pelton wheel shaft and operating a small hydraulic valve which admits or releases water under pressure from the main pipe to a hydraulic cylinder fixed to the steel underframe, and connected by suitable links, and a lever to the shaft before mentioned. The water is passed through a filter on its way to the hydraulic valve. This arrangement of governing has proved highly [illegible]

The main shaft of the Pelton wheel is supported by two extra long self-oiling bearings, one on each side of the casing. These bearings with bearing blocks are carried on two heavy cast-iron standards, and the whole is fitted up on a steel underframe, which is extended so as to carry the electric generator. The coupling between the Pelton wheel and the generator takes the form of a [illegible] assists the regulation of speed.

The upper half of the casing is movable and two large doors are fitted to the side of it, giving access to the wheels, nozzles, etc. The water is discharged from the two wheels through an opening in the foundation. The wheels and buckets are of cast steel. This double Pelton wheel is employed in mining works in Spain, and operates under a head of 277 ft., makng 424 revolutions per minute, and giving [illegible]

Morgan Tilting Furnace for Birmingham University.

In the current number of the Birmingham University Engineering Journal is described the new Morgan patent tilting furnace, presented to the University by the Morgan Crucible Company, Ltd. The furnace body consists essentially of a cylindrical steel shell lined with Battersea bricks. The Salamander crucible used is permanently fixed in the centre of the furnace, and is

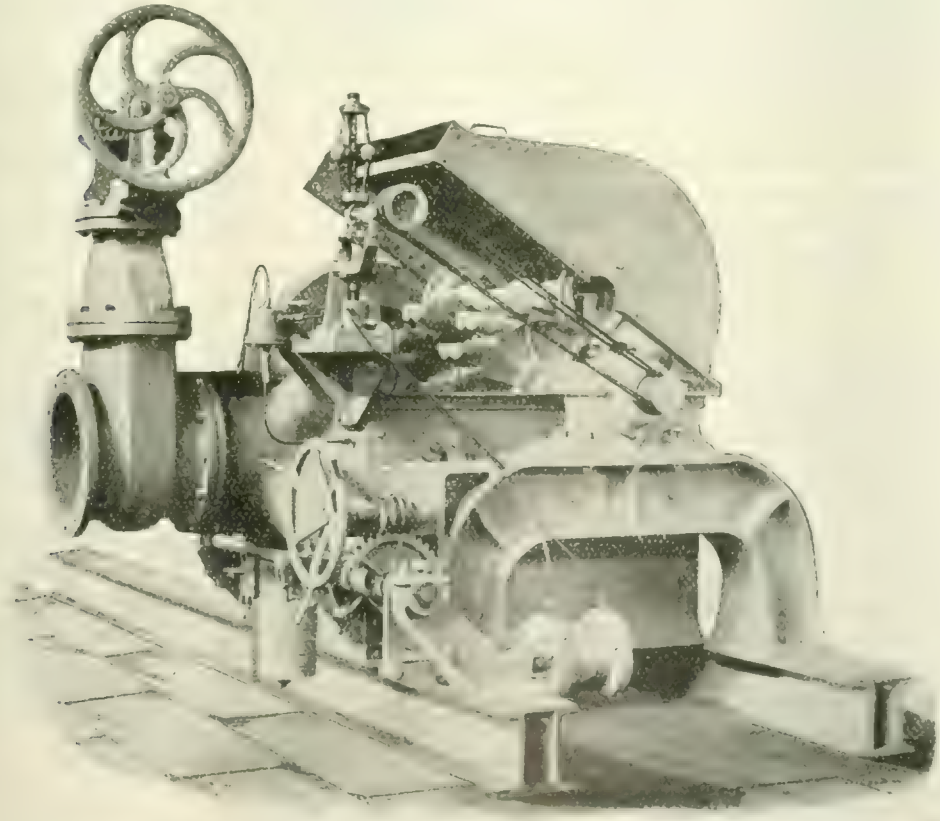


FIG. 2.—DOUBLE PELTON WHEEL

Fitted with two regulating nozzles controlled by combined Pickering hydraulic governor.

[illegible] through the [illegible] the furnace. W[illegible] large in the [illegible] for pouring. The furnace body may [illegible] whole so that the contents of the crucible are poured direct into the moulds placed underneath.

The body of the furnace is secured to a base ring adapted to stand on a bed plate, and carries the grate, which is in three parts, the centre part fixed, and the side pieces movable. The base ring contains eight slots to allow the introduction of the air through the appertures in the circular casing and the lining of the furnace. The grate supports the stand upon which the crucible is firmly seated, and held in position at the top by specially designed grips. The bed plate supports the body of the furnace and contains a portable ash tray, which is so designed that in the event of a heavy leak it would receive the whole of the charge, and being of a suitable shape would easily discharge a cake of metal. The flue pipe is made with double walls to form an annual passage whereby the escaping gases heat the incoming supply of air.

The larger sizes of these furnaces are also provided with an ingenious device, known as a preheater, in which the waste of the heat furnace is utilised for heating up charges of light or bulky metal, which are afterwards added to the charge in the crucible. It is moreover useful for feeding the crucible during the melt. Furnaces of this type have also been designed, which may be carried bodily by a crane to any part of the foundry, this arrangement ensuing complete control over, and absolute uniformity of, the casting temperature.

The Labour Market.

Board of Trade statistics for last month record a satisfactory improvement in employment. The pig iron, iron and steel and tinplate trades were all brisk, and there was an improvement in both the engineering and shipbuilding trades. The coal mining industry showed an improvement apart from the seasonal change at this time of the year. As compared with a year ago, there was a general improvement in all the principal industries except the building trades. Employment in the pig iron industry continued good and was better than both a month and a year ago, as will be seen from the accompanying table.

Districts.	Number of Furnaces, included in the returns, in Blast at end of Oct., 1905.	Sept., 1905.	Oct., 1904.	Increase (+) or Decrease (−) in Oct., 1905 as compared with A month ago.	A year ago.
England & Wales—					
Cleveland	87	85	77	+ 2	+ 10
Cumberland & Lancs.	36	34	32	+ 2	+ 4
S. and S.W. Yorks.	16	16	14	...	+ 2
Derby & Nottingham	38	38	37	...	+ 1
Leicester, Lincoln, and Northampton	28	27	25	+ 1	+ 3
Stafford & Worcester	34	32*	28	+ 2	+ 6
S. Wales & Monmouth	14	15	15	− 1	− 1
Other districts ...	7	7	6	..	+ 1
Returned from England & Wales	260	254*	234	+ 6	+ 26
Returned from Scotland ...	71	72	70	− 1	+ 1
Total furnaces included in returns	331	326*	304	+ 5	+ 27

PIG IRON LABOUR RETURNS.

The number of furnaces now in blast is greater than in any month since November, 1900.

In iron and steel works (*vide* table) employment continued to improve, and works generally are now quite as busy as in a good year like 1900. Compared with a year ago nearly 7,500, or 8·6 per cent. more workers were employed at the works covered by the returns received.

	Number of Workpeople employed by firms making returns			Average Number of Shifts worked per man		
	In week ended Oct. 21st, 1905	Increase (+) or decrease (−) as compared with A month ago.	A year ago.	In week ended Oct. 21st, 1905	Increase (+) or decrease (−) as compared with A month ago.	A year ago.
Departments.						
Open-Hearth Melting Furnaces	9,311	+ 246	+ 716	5·90	...	+ 0·05
Crucible Furnaces	536	− 6	+ 39	5·56	+ 0·03	+ 0·08
Bessemer Converters ..	1,967	− 92	− 47	5·10	...	+ 0·30
Puddling Forges.	10,048	+ 337	+ 476	5·14	+ 0·14	+ 0·28
Rolling Mills	30,176	+ 254	+ 1,845	5·42	+ 0·12	+ 0·22
Forging and Pressing ..	3,853	− 27	+ 649	5·65	+ 0·10	+ 0·14
Founding	11,951	− 178	+ 1,138	5·83	...	+ 0·06
Other Departments ...	9,528	+ 415	+ 1,274	5·83	− 0·01	+ 0·10
Mechanics, Labourers	17,609	− 139	+ 1,353	5·86	+ 0·05	+ 0·09
Total	94,469	+ 810	+ 7,448	5·61	+ 0·05	+ 0·16
Districts.						
Northumberland & Durham	11,811	+ 93	+ 613	5·65	+ 0·03	− 0·06
Cleveland .	8,518	+ 151	+ 116	5·66	0·04	+ 0·24
Sheffield and Rotherham ...	17,532	− 124	+ 2,200	5·69	+ 0·02	+ 0·17
Leeds, Hull and other Yorkshire Towns	4,242	22	+ 673	5·64	+ 0·04	+ 0·27
Cumberland, Lancs & Ches	11,584	− 141	+ 28	5·59	+ 0·21	+ 0·29
Staffordshire	10,106	+ 28	+ 855	5·41	− 0·0[illegible]	+ 0·70
Other Midland Counties ..	4,376	− 19	+ 335	5·44	+ 0·08	0·20
Wales and Monmouth ..	9,256	+ 173	+ 1,169	5·67	+ 0·05	+ 0·03
England and Wales ...	77,425	+ 139	+ 5,981	5·60	+ 0·04	+ 0·16
Scotland	17,044	+ 671	+ 1,467	5·64	+ 0·14	+ 0·15
Total ...	94,469	+ 810	+ 7,448	5·61	+ 0·06	+ 0·16

IRON AND STEEL RETURNS.

Employment continued slack in North Wales with slate quarrymen and slate makers. In the Festiniog district employment was very slack, and some quarries were only working four days per week.

APPLICATIONS OF ELECTRICITY IN THE ROYAL GUN FACTORY.

By Colonel H. C. L. Holden, R.A., F.R.S.

THE question of the relative merits of individual motors for driving machine tools versus motors driving groups of tools has often been discussed, but no hard-and-fast line can be laid down as to when either system should be used, except, perhaps, for tools which require a large amount of power, certainly not less than 10 h.p. or 15 h.p., as a minimum.

I may here explain for the benefit of the few of those present who do not already know it, that the work of the Royal Gun Factory consists of the manufacture of guns ranging from [illegible] cwt. up to [illegible] tons, or even more, and also in the manufacture of the breech mechanisms or other adjuncts and appurtenances of the guns themselves. This work necessitates a very large range of machine tools from boring machines 50 yards in length and lathes of 100 ft. bed, down to the smallest milling machines and lathes. There is therefore plenty of scope and opportunity for the employment of different descriptions of electrical drives. In 1900 I converted the first of two large boring machines to a direct electric drive by means of a variable speed Schuckert four-pole motor of 25 b.h.p. (fig. 1). The variation of speed was obtained by the now well-known method of varying the excitation of the fields, and the ratio in this case was 1 to 35 or so, giving speeds of from 25 r.p.m. to 880 r.p.m., which is amply sufficient range without any further gear, for the work put into these machines

BORING MACHINES DESCRIBED.

The machines themselves are of the simplest possible description. The headstock which revolves the work carries between its bearings a large worm-wheel (fig. 1), which is driven by a worm-shaft forming a continuation of that of the motor, but connected to it by a flexible coupling; the thrust of the worm-shaft, which in such large machines is very considerable, amounting to tons in some cases, is taken by a thrust bearing of marine type, and through this the cutting lubricant passes on its way to the boring bar. The worm and worm-wheel together with the electro-motor drive is ideal. It would be impossible in a spur-gear driven machine, I believe, to fine bore a hole 12 in. to 20 in. in diameter and up to 50 ft. in length without a variation of [illegible] in. in diameter, which is what these boring machines are called upon to do, and do to perfection, daily.

The feed of the boring bar in the machines described is worked from the motor by means of a shaft which connects it with change gear, similar to that of a lathe, at the other end of the bed, 150 ft. away. At this end there is also a 15-h.p. series motor, which can be mechanically coupled to the screw shaft moving the boring head and saddle, with the object of withdrawing or advancing one or both rapidly in either direction as required; in this case I have introduced a slip coupling (fig. 2); this is better in many ways than the overload release. It may be interesting to point out that the change to motor driving, and the improved control of the speed, enabled the factory to turn out at once more than double the former amount of work done per week.

LATEST METHOD OF DRIVING.

A later development of this method of driving is shown in the diagram of this feed gear in fig. 3. The action of the gear is as follows: The motor drives the shaft through a flexible coupling, H. This shaft carries on it the magnetic clutch, B, and beyond the clutch the worm, C. It also carries on a sleeve a pinion, and the overload clutch, G, and an armature. The worm gears into the worm-wheel above it, from which the change gear, D, similar to that of a screw-cutting lathe, and situate behind the worm-wheel, drives a horizontal shaft on which another worm engages with a second worm-wheel, E. This latter can be clutched mechanically by the claw clutch, A, to the screw shaft, I, actuating the saddle. The claw clutch, A, is moved by a hand-wheel in and out of position, and the lever, F, that moves carries a contact which only allows of the magnetic clutch, B, being in action when the claw clutch is disengaged. Thus, normally, the drive is through the worm-wheels and the change gear, but when it is desired to move the saddle quickly, the magnetic clutch is energised, and the pinion on the motor shaft then drives a spur-wheel which is keyed to the screw shaft, I, the latter being thus driven direct. The feed can be varied [illegible] to the extent required between the extrem

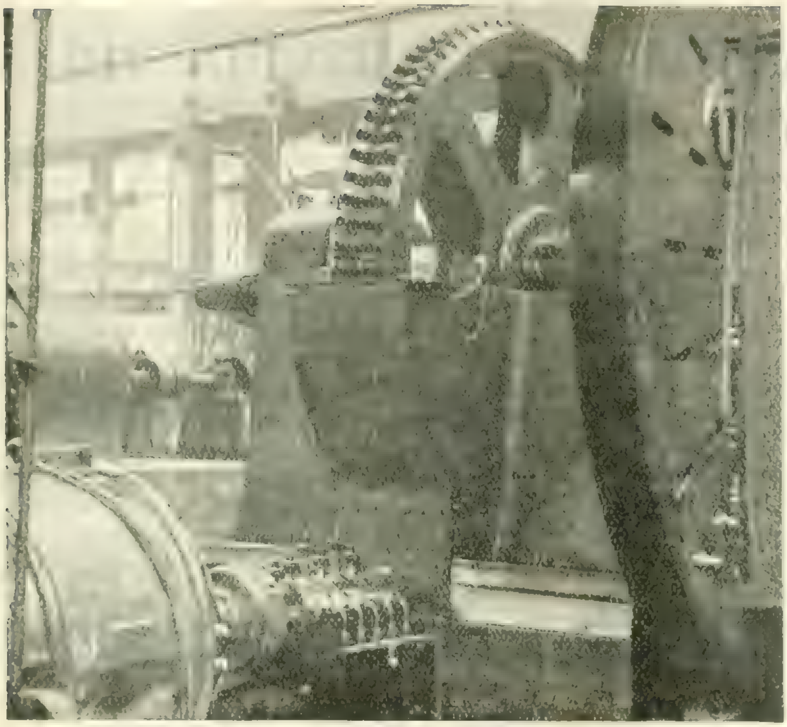


FIG. 1. VARIABLE SPEED SCHUCKERT 4-POLE MOTOR USED FOR DIRECT DRIVING OF LARGE BORING MACHINES.

The headstock which revolves the work carries between its bearings a large worm wheel, driven by wormshaft.

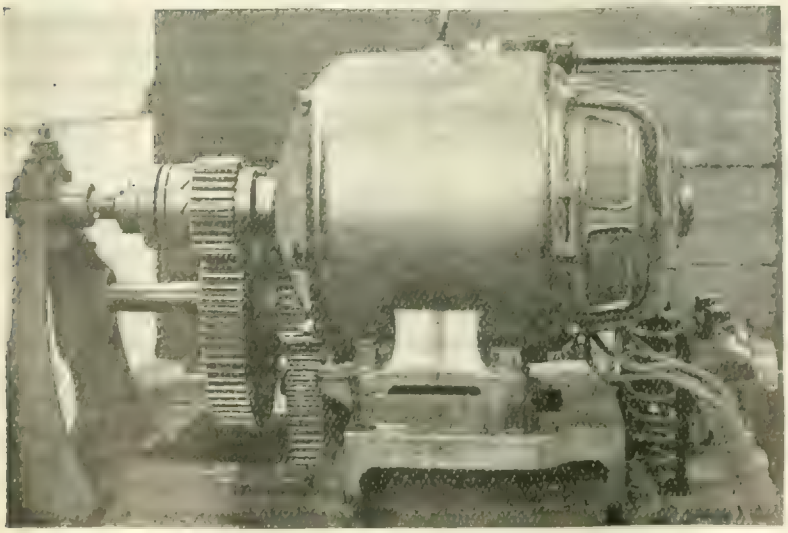


FIG. 2. [illegible] COUPLING USED IN CONNECTION WITH ELECTRICAL DRIVING AT WOOLWICH ARSENAL.

[illegible] by the [illegible] of change gears or the varying [illegible] of the motor. This [illegible] is worked [illegible] from the main switchboard, by which the man starts and stops and controls the speed of the [illegible] the [illegible] switches are so [illegible] [illegible]trically that it is [illegible] either to start [illegible] or to [illegible] the main motor [illegible]. A magnetic [illegible] is employed in connection with this gear, and 117 of these [illegible] are in daily use in the gun factory.

GAUGE-ROOM.

[illegible] of the gauge-room, see Fig. [illegible], shows the method of driving the lathes and other machine tools which was introduced when the shop was remodelled some four or five years ago. In the new arrangement the motor [illegible] h.p., is attached to the wall and drives the main shaft which runs down the centre of the shop, by means of a belt at a point about midway in its length at a speed of [illegible] revs. per minute.

There is none of the usual countershafting and its multiplicity of belts; instead there is one cone pulley over each machine, driving the machine in the usual manner with a belt. These cone pulleys are, however, not carried on the main shaft, but on tubular bearings through which the main shaft passes quite clear, while the bearings themselves are supported on brackets: the pull of the belt thus does not come upon the shaft when the cone pulley is not running and the machine is idle. The cone pulley carries [illegible] with [illegible] collecting rings [illegible] to the shaft. The [illegible] position. [illegible] is given to the [illegible] given to the [illegible] the gallery [illegible] simple method no spring or other device is required to keep the surface [illegible] losses are reduced [illegible] machines [illegible] motor driving belt is thrown off and there is no current [illegible] shaft can be [illegible] The switches used to actuate the clutches [illegible] that is, when the current [illegible] off, a pull at the switch rope puts it on, and a second [illegible] the current off again. [illegible] practical experience to be more convenient than the [illegible] belt-shifting method [illegible] two ropes are employed one to put the power on and another [illegible] off. [illegible] a condenser to render the extra current innocuous on [illegible]

NORTH-EAST SHOP.

[illegible] the most recent shop built in the Royal Gun Factory, and was designed with a view to electric driving. The work done in this shop is in connection with the smaller kinds of guns and their mechanisms. It is a lofty building measuring 200 ft. by 120 ft., with the now common saw-tooth roof, and divided into four bays running east and west. There is a gallery running all round it for fitters and bench work, offices, etc., and the large amount of glass makes it very light. Each bay is served by two 8-ton electric cranes. Altogether on the ground floor there are 83 machine-tools, of which 21 are separately motor-driven, the other 62 being grouped and driven from one of the four main shafts which serve the same number of bays. The method of driving these main shafts 200 ft. long is by means of a 30-h.p. motor (fig. 4) suspended from the girders and situated in the centre of the shaft, to each half of which it is coupled direct; the speed of the shaft is 250 r.p.m.

As in most modern workshops it is the custom to grind the workmen's tools for them, and not allow them to do this for themselves in the old-fashioned haphazard way on a grindstone. In the grindery devoted to this work some 12 Gisholt tool-grinders are continuously in use, and the problem to be solved was to drive them in the most economical and efficient manner. The grinders were arranged half on either side of the shop, and were driven by belting from a shaft running at very nearly the same speed as the wheels, and coupled direct through a flexible coupling to a 6-h.p. shunt motor standing on a bracket fixed to [illegible] The speed of the shaft is [illegible] r.p.m. Besides the tool grinders there are also two small cutter-grinders, and in order to drive these latter, which are placed across the shop, it was necessary to have a shaft running at right angles to the other two. As the power required was small, this motion was transmitted by a friction disc and wheel, the wheel being advanced so as to be in contact with the disc when it is required to rotate the shaft, which consists of a thin steel tube and runs at 2,500 r.p.m. Some doubt was expressed as to the life of these high-speed shafts and bearings when they were first erected, but as they have been working for the last three years with practically no wear it is evident there is no need for apprehension that they will not last. The economy in transmission here is considerable.

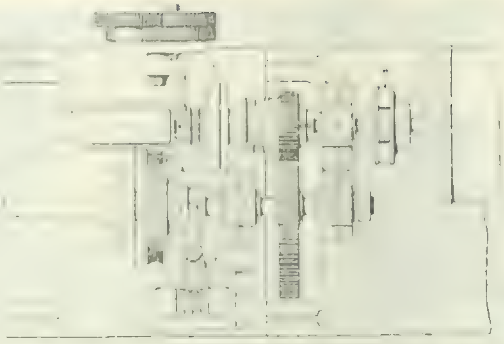
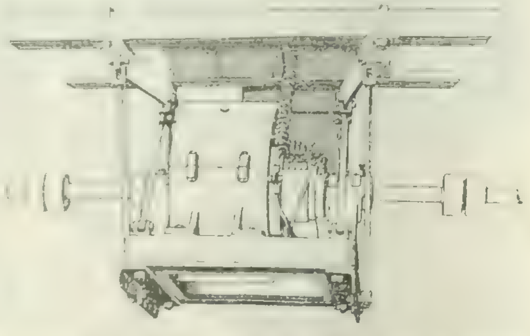


FIG. [illegible]—DIAGRAM OF FEED GEAR USED IN CONNECTION WITH LARGE BORING MACHINE.



[illegible] 4.—METHOD OF DRIVING MAIN SHAFTS IN NORTH-[illegible] SUSPENDED 30-H.P. MOTOR.

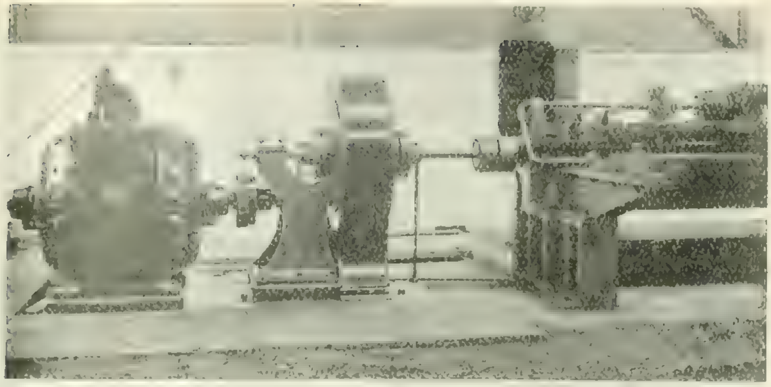


FIG. 5.—A LARGE ELECTRICALLY DRIVEN RIFLING MACHINE FOR 12-IN. GUNS.

RIFLING MACHINE.

The method of driving a large rifling machine for 12-in. guns is shown in fig. 5. The term "rifling," of course, is applied to the operation of cutting the grooves which run spirally along the bore of a gun. In order to do this a bar carrying one or more tools to cut the grooves, is drawn through the gun, and turned as it is moving to give the required twist. The saddles which guide the bar are carried on a bed within which is the screw for actuating the bar; as this screw revolves in one direction or the other, [illegible] the bar is moved in or out of the gun. Cutting is always done by pulling the bar through, not pushing it, and indeed I may remark that in boring operations it is always better to have the cutter bar in tension than in compression. The end of the screw is coupled to a shaft passing right through the gear box and supported in the bearing shown on the left of it in the picture.

MAGNETIC CLUTCHES

This shaft carries two magnetic clutches one on either side of the gear box. The motor of 30 h.p. drives a pinion which is always in gear with the teeth of the large internally geared wheel and also with a small spur wheel, running on the same centre as the former, but of course in the opposite direction. A clutch on the left connects the screw shaft to this latter wheel, whereas the clutch on the right attaches it to the internally geared wheel. It will be obvious that the direction of rotation of the screw shaft will be different, according as one clutch in is action or the other, and owing to the different [illegible] of the gears a quick return motion when not cutting is obtained. The motor and the gears run continuously in one direction, and therefore there is only the momentum of the [illegible] and inertia of the screw [illegible] with the rifling bar to [illegible] on reversal of its motion. The action of reversing is entirely automatic, and worked by the movement of the rifling bar saddle. This drive works very smoothly and well. It [illegible] the rifling of a 12-in. gun to be carried out in 40 hours, six [illegible] being cut simultaneously. [illegible] only a few years ago the same operation, with one tool only cutting, took more than three weeks, working day and night. No less than twenty-[illegible] have to be taken to cut each [illegible]

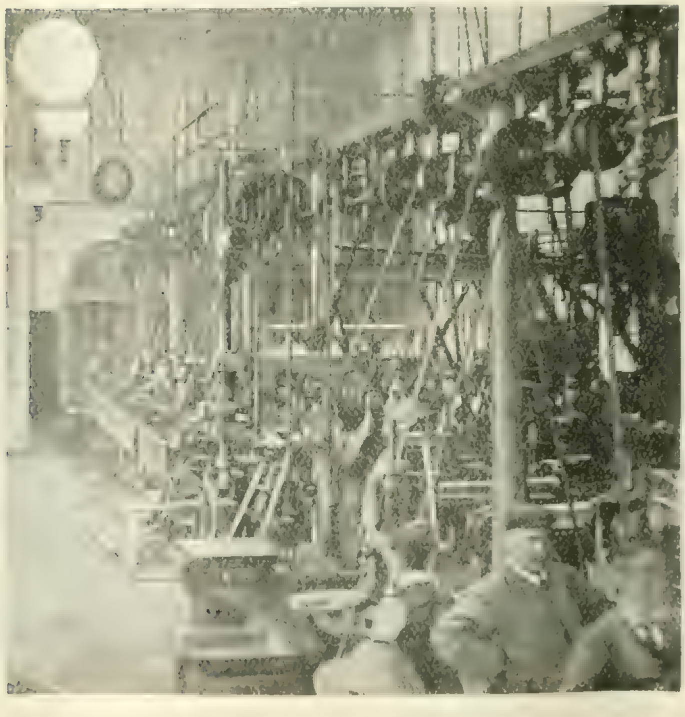


FIG. [illegible]—[illegible] OF [illegible] SHOP, ROYAL GUN FACTORY.

LAPPING MACHINES.

For lapping the [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] manufacture and sometimes after the gun has been in use, there are three machines in the factory. Two of [illegible]

The largest of the three machines is devoted to the larger guns, such as the 9·2-in. and the 12-in., and the motor is mounted above the saddle which carries the lapping shaft and drives the latter by means of a short link belt. The large pulley is attached to the shaft by a feather sliding in a featherway cut the whole length of it, and in this manner rotates the lapping head. [illegible] the bed by a screw extending the whole length of the bed, and similar to the leading screw of a lathe. This screw, however, is stationary, and the traversing motion of the saddle is produced by means of a revolving nut, which is driven also by a linked belt, and through reducing gear from a pulley carried on the other end of the motor shaft. The quick to-and-fro motion is given to the bar by the sleeve, which is clamped on to the bar between the two cheeks of the saddle, and has cam grooves around it in which guide blocks fixed to the saddle are made to engage when required.

The liquid reverser, worked either automatically or by hand, is in front of the starting switch. The tightening of the belt is accomplished by sliding the motor across the saddle, and can be done by the hand-wheel when the machine is running.

PLANING MACHINES

[illegible] in both directions [illegible] two separate tools whenever and wherever it is possible, the economy in power, time, and labour being greater than having a quick return stroke, for it is obvious that however rapid the return stroke may be, time is lost, and no useful work is done. This will explain why the gear is so designed that the speed of the table in either direction is the same. In the case of planing machines, as in the case of the boring machines, I hold a strong brief for the screw drive as against the rack and pinion drive. The former undoubtedly does the better work. The planing machines are driven by a shunt-wound variable-speed motor, which runs continuously in one direction, and drives, by means of a bevel pinion, two bevel wheels revolving in opposite directions. These two bevel wheels are concentric with the shaft which drives the screw of the planing machine, and are each furnished with a magnetic clutch, by which they can be attached to the shaft, the clutches [illegible]

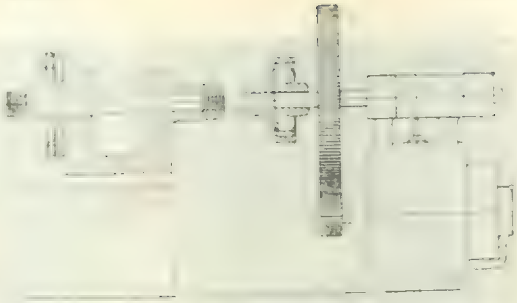


FIG. 7.—BALL BEARING OF LARGE DIAMETER, FORMING BACK OF FACE PLATE WHICH TAKES THE THRUST OF THE BORING TOOL.

[illegible] tappets on the [illegible] planer. The reversing action of these machines is very quick and silent. No check or change of speed is discernible in the motor, though of course the ammeter shows a momentary rise of about 25 per cent. on the reverse.

On a preceding page was described a separate-feed arrangement for a large boring machine, and I now propose to illustrate a smaller one for high speed solid boring fitted with a somewhat similar arrangement. The machine itself has a mandrel, which is driven by a motor, through a single reduction gear, for the reason that, although it would have been preferable to drive it direct from the motor shaft, this was not practicable, owing to the comparatively low speed required; the thrust of the boring tool (which is very considerable) is taken by a ball-bearing of large diameter forming the back of the face plate (fig. 7), a device which has been very effective.

[illegible] shown in fig. 8. This, as in the other example, fulfils two functions, viz., that of the actual feed of the tool into the work, and also the quick withdrawal and advance of the same. In this instance two clutches are used, in conjunction with a claw clutch; and besides the safety arrangement provided to prevent the feed gear running after the

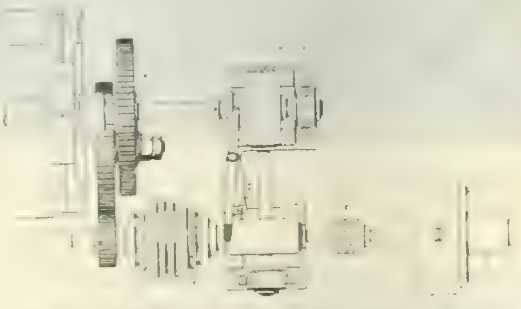


FIG. 8.—FEED GEAR FOR HIGH-SPEED SOLID BORING MACHINE.

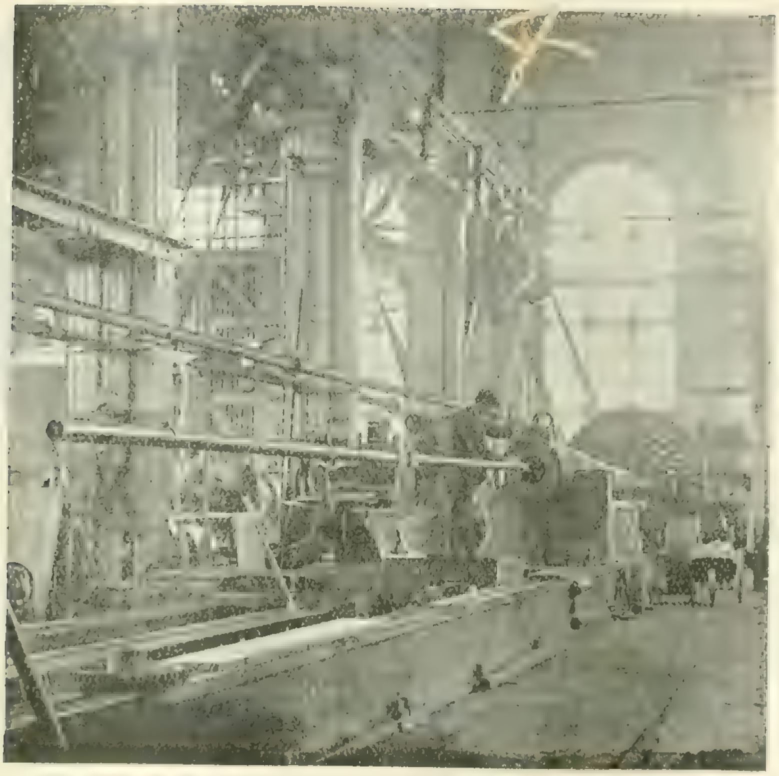


FIG. 9. ILLUSTRATING APPLICATION OF ELECTRICITY TO ASCERTAINING AMOUNT OF ECCENTRICITY IN THE BORE OF A GUN.

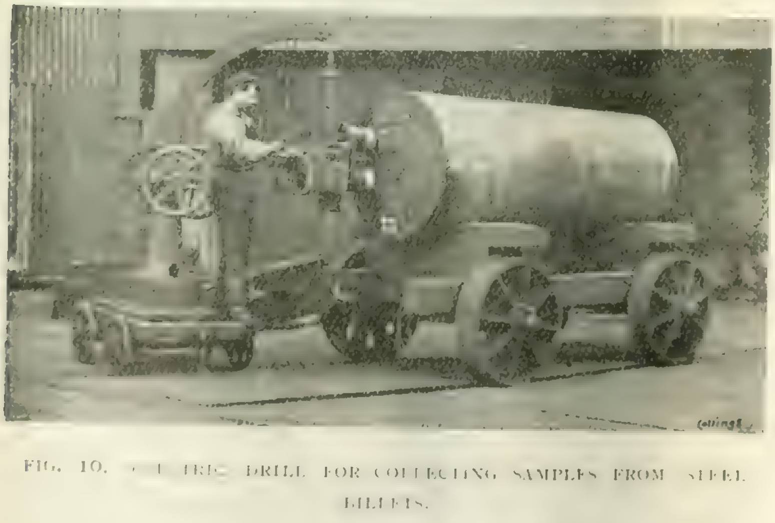


FIG. 10. ELECTRIC DRILL FOR COLLECTING SAMPLES FROM STEEL BILLETS.

[illegible] of being started before the other is in motion, there is also a switch worked by the lever actuating the claw clutch, which prevents the two [illegible] short circuit [illegible] the [illegible] being operated. When the feed is in operation the motor is clutched to the first worm shaft, and turns the first [illegible] wheel, which in turn drives the worm of the second worm wheel, and the claw clutch being engaged the [illegible] is driven, and the [illegible]lles carrying the boring bar advanced. If, however, it is desired to withdraw the bar rapidly, the claw clutch is withdrawn, and the motion of the lever actuating this allows the second magnetic clutch to be rendered active. This then clutches the pinion to the motor shaft, and drives the spur wheel through the intermediate wheels, the [illegible] of the [illegible] [illegible] inches per hour, whilst the [illegible] return is [illegible] thirteen times faster.

Electricity [illegible] in ascertaining the amount of eccentricity of the bore of a gun. The difficulty of ascertaining, and [illegible], measuring the want of truth in the bore of a gun 20 ft. to 30 ft. [illegible] appreciated [illegible] gun 45 ft. in length.

The means adopted, however, are, thanks to electricity, quite simple (fig. 9). A tapered [illegible] with a single [illegible] bring both [illegible] the tube to the same level, carries at one end a knife-edged contact wheel about 2 in. in diameter, this wheel being insulated from the tube, but connected to a flexible conductor passing down the interior of it to the other end of the tube which is fixed in the slide rest; a dead beat galvanometer and a couple of dry cells complete the equipment. When the wheel touches [illegible] of the gun the circuit is

[illegible]

ELECTRIC DRILL.

W[illegible] arrives in the factory, the first [illegible] for chemical analysis. This is generally [illegible] form of the drillings from a point midway between the centre and exterior [illegible] at both ends. Until current was generally available throughout the factory this was quite a lengthy operation, involving the loss of time taken to fix a ratchet brace, and then the time to drill the hole in order to obtain the [illegible] by the aid of the electric drill, the time lost in fixing is eliminated entirely.

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] Material [illegible] per hour	[illegible] per Minute
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
R[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
L[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Me[illegible]	[illegible]		[illegible]		[illegible]	
D[illegible]	[illegible]				[illegible]	[illegible]
[illegible]					[illegible]	[illegible]
Heavy [illegible] machine	[illegible]				[illegible]	[illegible]
He[illegible] chine	[illegible]		[illegible]		[illegible]	[illegible]
Rad[illegible] d[illegible]	[illegible]				—	[illegible]
1¼ in. high-speed twist drill	[illegible]					[illegible]
[illegible]	[illegible]			—	—	[illegible]
1¼ [illegible]	[illegible]					[illegible]

TABLE SHOWING AMOUNT OF MATERIAL REMOVED PER E.H.P. PER MINUTE ON VARIOUS MACHINES.

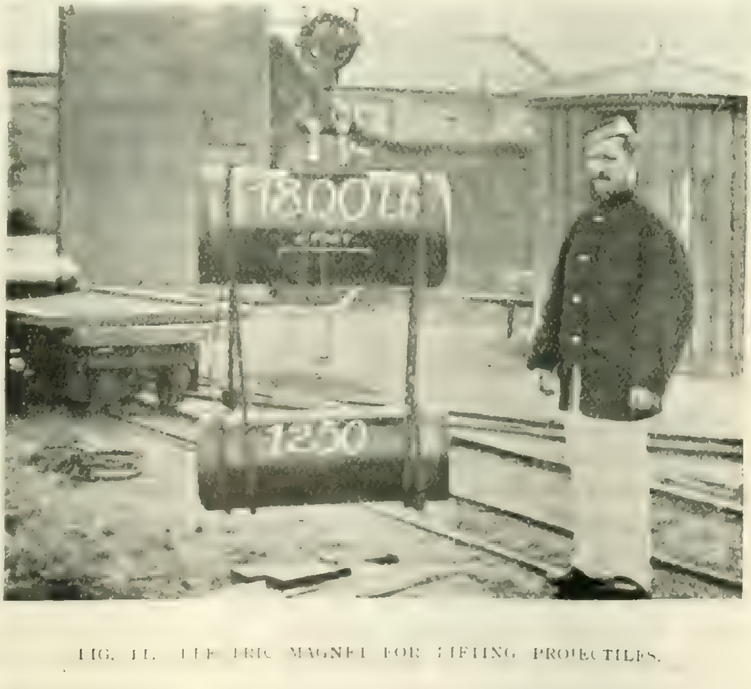


FIG. 11. ELECTRIC MAGNET FOR LIFTING PROJECTILES.

I feel that my list of applications would not be complete if I omitted to refer to the use of the electro-magnet for lifting projectiles (fig. 11), which was introduced when the 110-ton gun was in use. The cast-iron projectiles for proof were exceedingly awkward things to remove from the pile and sling for the crane to lift; this was made delightfully easy by substituting an electro-magnet for the sling. The magnet used consisted of one piece of mild steel of ⊓ section and [illegible] in. in length with a single coil wound round it longitudinally. The surface magnetised was 3[illegible] square inches, and the maximum weight it had to support 1,800 lb., the weight of the projectile of the 110-ton gun, though, it is clear, there was ample power to spare. The weight of this magnet, complete with the shackles for attaching it to the crane hook, was under 56 lb., and the electrical energy required for the maximum lifting power was 120 watts.

In any large gun factory, or indeed in any factory where large makes of steel are heated, forged, and tempered, or otherwise treated, it has long appeared to be [illegible] that some means should be provided [illegible] ing temperatures. The measurement of [illegible] the electromotive force generated by a thermo-couple has been found to be the best adapted for the work of the gun factory.

[illegible] are at work at the present time in the Royal Gun Factory 134 motors of an aggregate rated horse-power of 1,903, whilst there are 61, either connected or ready to be connected to the supply mains when current is available, of an aggregate rated power of 840 h.p. more. They consist of one motor of 100 h.p., one of 50 h.p., six of 40 h.p., 30 of [illegible] h.p., 29 of [illegible] h.p., and [illegible] the remainder being under 10 h.p. and ranging down to one h.p. The largest motors, viz., 100, 50, and 40 h.p., are all connected to individual machines. The number of magnetic clutches in use is [illegible] rated at [illegible] and [illegible]. The table on preceding page gives a few data as regards the amount of material removed per E.H.P. per minute on various machines—the E.H.P. being the gross amount required not only to drive the motor and machine but also to [illegible].

Abstract of a paper read before the Institution of Electrical Engineers.

THE L.C.C. AND ROAD LOCOMOTIVES

At Tuesday's meeting of the L.C.C. attention was given to the important subject of the better regulation of road locomotives in the streets of London, and we imagine that most Londoners will be disposed to endorse very heartily the action of the Council in this matter. Not long ago, when earthquakes were the subject of marked attention in the press, more than one Londoner, startled from slumber by the shaking of his walls, may have risen in the night to carefully note the time of a well-marked seismic disturbance, only to be disillusioned the next moment as one of these heavy locomotives resumed its fitful progress, and spread its earth tremors lower down the street.

As one of the members pointed out, the time has arrived when the law affecting road locomotives should be brought into line with the recent laws affecting motor cars. The Council in seeking confirmation of their new bye-laws, will ask the President of the Local Government Board to promote legislation amending the Locomotives Acts on the following lines:—(1) That all locomotives and trailers shall be fitted with suitable springs; (2) that licensing authorities shall be empowered to refuse to licence any locomotive which is not so constructed as to avoid unnecessary noise or vibration, subject to an appeal to a magistrate in case of dispute; (3) that the weight of engines shall not exceed eight tons on any axle (such weight to apply to towns only); (4) that the weight of a trailer and load shall not exceed 12 tons; (5) that licensing authorities shall be empowered to weigh vehicles; (6) that the present limit of width of locomotives and trailers, viz., 9 ft., shall be reduced; (7) that no locomotive shall be allowed to draw more than two trailers in towns.

Several matters of more than ordinary interest came before the London County Council at this meeting, and one of their first proceedings was to pass a resolution urging the importance of an immediate reform in the control of the Port of London. As regards the proposed Charlottenburg scheme, Sir W. Collins, in answer to an inquirer who wished to know whether the £100,000 promised some time ago would be forthcoming, said he believed he was correct in stating that the members of the Departmental Committee "had received information which pointed to the probability of the funds promised being forthcoming, either from public or private sources, as soon as the details of the scheme were issued."

SHIPBUILDING NOTES.

THE first vessel to make use of the new Trafalgar graving basin at Southampton was the steamship [illegible] tons register. Only slight overhaul was needed, and the South African mail boat left again within twenty-four hours, giving place to the Red Star Line *Vaderland*, of 12,018 tons.

On Monday, Messrs. William Gray and Co., Ltd launched the *Samara*, a steel screw steamer, which they have built for Messrs. Maclay and McIntyre, Glasgow. She is of the following dimensions:—Length overall, 342 ft.; breadth, 49 ft 2½ in.; and depth, 24 ft. 3½ in. with long bridge, poop, and topgallant forecastle. Triple expansion engines are being supplied by Messrs. Blair and Co., Ltd., Stockton, having cylinders 24 in., 39 in., and 64 in. diameter, with a piston stroke of 42 in., and two large steel boilers for a working pressure of 180 lb. per square inch.

Messrs. Furness, Withy and Co., Ltd., Hartlepool, launched on Monday the large vessel *Clan Matheson*, which they have built to the order of the Clan Line. The vessel is over 400 ft. in length, of the three-deck type, with two steel decks laid all fore and aft, and is classed 100 A.1 at Lloyd's. The total capacity of the vessel is 431,718 cubic feet. She has five large hatchways, ten powerful steam winches, large multitubular donkey boiler, twelve derricks, powerful windlass, patent steam steering gear fitted under bridge, also hand gear. Girders and wide spaced pillars are fitted in holds in lieu of stanchions, leaving the holds clear for taking in large cases of machinery. Triple expansion engines will be supplied and fitted by Messrs. Richardsons, Westgarth and Co., Ltd., Hartlepool, with cylinders 26 in., 43 in., 71 in., by 48 in. stroke; the two boilers, 16 ft. 2 in. by 11 ft. 9 in., and 200 lb. working pressure, are fitted with Howden's forced draught.

On Saturday *Clan Macpherson*, a sister vessel to the *Clan Matheson*, described above, ran a satisfactory trial trip in Hartlepool Bay, and attained a speed of 13 knots. The vessel afterwards proceeded to Glasgow.

A steel screw steamer of the following dimensions was launched on Monday from the yard of Messrs. Ropner and Son, Stockton-on-Tees: Length, 366 ft.; breadth, 53 ft.; depth, 30 ft. 4 in. The vessel is classed 100 A1 at Lloyd's, and has been built to the order of Messrs. R. Ropner and Co., West Hartlepool. She is fitted with the builder's patent improved trunk deck, having a tier of hold beams, in addition to the complete trunk deck, and has also a top-gallant forecastle. Her deadweight carrying capacity will be about 7,300 tons on Lloyd's summer freeboard. The appliances for loading and discharging expeditiously include extra derrick posts and double derricks, double steam winches at hatches, steam being supplied by a patent multitubular donkey boiler. The engines, by Messrs. Blair and Co., Ltd., will be of the triple expansion type, of about 1,850 i.h.p., steam being supplied by two extra large main boilers at a working pressure of 180 lb. per square inch.

The new first-class cruiser *Warrior* was launched from Pembroke Dock on Saturday. She is 505 ft. long, 73 ft. 6 in. in breadth, has a mean draught of 27 ft., a displacement of 13,550 tons, an estimated h.p. of 23,500, and speed of 22·33 knots. Her total weight, including armour, is 8,015 tons. The *Warrior* belongs to the first cruiser class in the British Navy in which the 6 in. gun has been dispensed with, and, although this has involved a reduction in the number of guns, the gain is enormous in the penetrating power of each shot fired. Assuming favourable conditions, so far as rapidity of fire is concerned, the *Warrior* will develop practically 835,000 foot-tons of muzzle energy for each minute's fire as compared with 829,000 foot-tons in the preceding ships; while but four years ago our fast cruisers—those of the County class, fitted only with 6 in. guns—developed a total of only 542,000 foot-tons. The important point, however, is that the *Warrior* may fire per minute forty-three shots, which can be effective at three miles distance, as compared with twenty-four in the immediately preceding ships of the *Duke of Edinburgh* class. The cost of the *Warrior* is about £1,100,000.

SEA DEFENCES.

BY BARON H. T. H. SICCAMA.

THE sea attacks the land principally in two ways by waves and by currents. When either of these forces works by itself they are comparatively simple to deal with, but combined they are formidable. Taking them one by one for study the action of the waves has the first claim.

The waves by themselves need not cause alarm, but it is different when currents aid their action.

The currents that mainly affect the sea coast are originated by the tidal wave, the influence of winds being intermittent, but in the open ocean they are hardly perceptible. The gulf stream in the Atlantic is merely a set in a constant direction. The length of a tidal wave is between 500 to 600 miles, its velocity about 50 miles an hour, and its amplitude about three feet on passing St. Helena or other islands rising steep out of the sea bottom. There no current is perceptible due to the tide, such as is usually caused by the trade winds or monsoons. Near large islands or continents it is different. At Cape Finisterre and the Lizard the tide rises 15 ft., and where the direction of the wave is deflected and it enters narrow sea arms or straits it rises still higher, to 18 ft. at Dover and Calais, to 40 ft. at Bristol, to 65 ft. on the coast of the Channel Islands.

THE NATURE OF THE PROBLEM.

In defending the dry land against the inroads of the sea, the problem resolves itself into two parts, first, to prevent the surf from eroding the dry land; secondly, to lead the current away from the coast line. To this end materials must be employed hard or tough enough to withstand the lifting force of the waves and their disintegrating action.

The choice of these materials is ruled by their cost. Blocks of the heavier rocks, granitic, porphyric, or basaltic, should be of a cube of not less than half the wave height beating on them. Blocks of concrete, as a rule of specific gravity less than natural rock, should even be larger, and then laid with their smallest sides against the approaching waves, moreover, with the understanding that their three dimensions do not greatly differ from each other, and their smallest cross section be not much inferior to the square of half the maximum height of wave.

The financial question has here to be considered, and the construction of masonry seawalls or heavy timbering on long coast stretches of agricultural land is out of the question, and impossible where the nature of the subsoil precludes the imposition of heavy loads on small areas. Then the weight must be spread out, and the almost natural employ of branches and twigs is indicated. The illustrations on page 1209 deal with various modes of construction.

Branches of almost any kind of tree, or their young shoots, can be made use of provided they are tough and straight, and from six to eight feet long; oak shoots, or ash, birch, willow, or hazel of about four to five years' growth, or fir branches of some kinds, can all be employed in some way or other. For light work, and on the outer slopes of dams of old construction, where no heavy surf is to be feared, the ground is first overlaid with a layer of clay, puddled more or less. This is first covered with straw to a depth, compressed, of half an inch. The straw, from rye or wheat by preference, must be straight, without tangles or weeds. It is spread flat at right angles to the slope. Over this the branches are laid, with the tops downward, and close together, till a thickness of from six to eight inches is attained. To keep this covering down stakes or pegs are driven eight inches apart in horizontal rows from three to five feet apart. The strongest, toughest, and longest branches are then bent alternately round the pegs, forming a low hurdle from eight inches to twelve inches high. Every third peg is bored through at right angles to the hurdle, for the insertion of a pin to keep the hurdle from floating up. The whole matting is then overlaid with rip-rap or brick-bats, of a size in accordance with the surf or wash expected on it.

THE USE OF "WISPEN."

For works of a heavier description use is made of long fascine bundles, locally called "wispen." They are made easiest on two rows of stakes, driven in slantwise, and crossing each other two by two. In this series of forks the branches are laid, breaking joints with tops all in one direction like a garland. They are then compressed into a bundle of from twelve to sixteen inches circumference, and fastened and tied with osier bands, six to eight inches apart, each third band being of double strength, as also the first and second from each end. They can be made of any desired length and used in many ways.

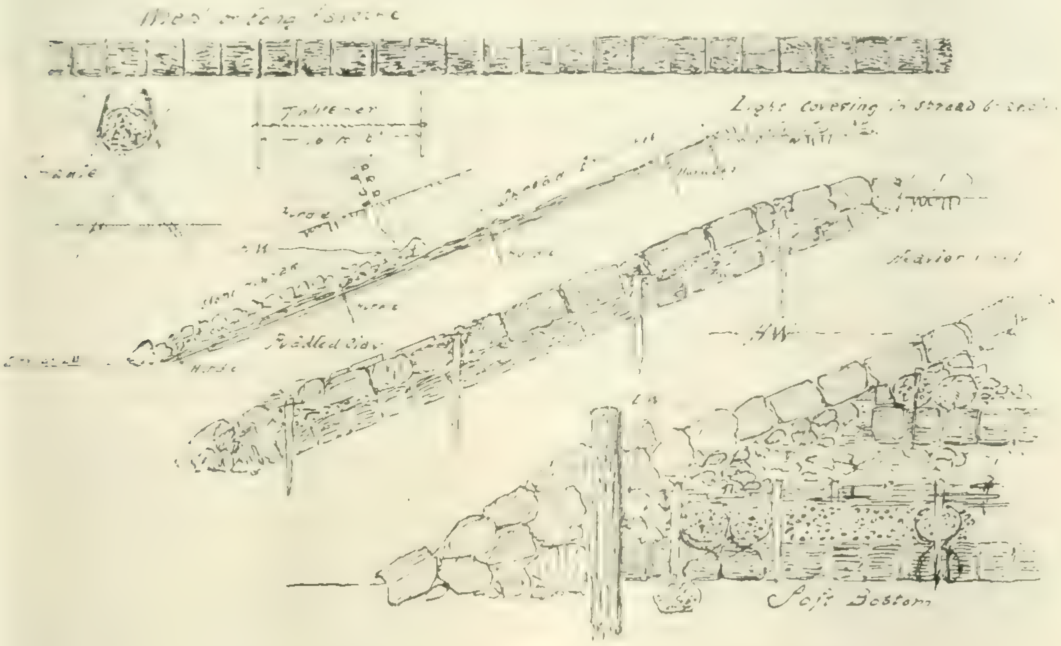
To cover the slope of a newly made dam they are laid close together in the direction of slope, sometimes on a preliminary matting of loose branches, and held down with hurdles of stout material. The heavy stone pitching is laid on, well fitted in like a rubble wall lying on its side. Although the slope is usually laid with a rise of one in four or one in six, to prevent the pitching slipping down, one or two horizontal rows of piles, mostly oak, of four to eight inches diameter, are driven, and one similar row at the foot, further strengthened with a low mound of the larger stones of irregular shape. Some builders leave the piles standing up two or three feet above the surface of the stone covering, others drive them down flush with it. The osier work should be strong enough to keep the heavy stones from sinking unequally into the earthwork, and yet elastic enough to allow them to sink down into any depression which might be due to settling or the wash of water underneath. This last should be guarded against with great care, as a watergang under the matting would soon eat into the soft earthwork and cause the destruction of the slope.

Where the foot of a dam never falls dry, another way of working becomes necessary. The " wisps " are then put together in the shape of a raft of one or more tiers.

METHOD OF CONSTRUCTION.

The lowest tier is made of bundles of a length to cover the whole slope, if possible ; at least, from the toe up to low-water mark, should this distance not exceed 50 ft. Crosswise over them are laid " wisps " ; first two together round the edges like a gang-board, and others between them at intervals of three or four feet. At the crossings all the parts are fastened together by strong osier ties, and stakes driven through. This raft, locally called " ryzen bed " or osier bed, is then floated to the intended site and grounded, with one side on the slope, where it is fixed by stakes or warps. The stone or ballast is then thrown on it, beginning with the edge nearest the dam, and then further out till the whole bed is sunk down equally. In this case there is no question of regular hand packing of the stone, but by careful sounding with rods, a pretty regular thickness of stone covering can be obtained.

This work is only applicable where an old dam exists



ILLUSTRATING METHODS OF CONSTRUCTION USED IN SEA DEFENCES.

Fig. 2

[illegible] upper [illegible], the water [illegible] disturbed. Where the sea is rough the whole, at least up to low water, must be built up in beds of a stronger kind, often 50 ft. wide by 600 ft. long, and consisting of from two to six tiers. For greater resistance against tearing strains, the bundle ends of alternate tiers are tied together, and the top of the bed overlaid with stout hurdles, of which the stakes also contribute to the toughness of the whole, dividing the surface into compartments forr to six feet square.

To avoid the forming of scour channels between the bed and the bottom, the lowest tier of fascines should be laid in the direction of the dam, fastened on underneath the lowest tier. The bed is then floated to the site, and the centre, first, everywhere covered and loaded over with lumps of stiff clay, by preference from flats already covered with some vegetation, locally called "schorklei," or "schorkloeten."

As soon as the centre of the bed begins to sink the edges are loaded, mostly with stone ballast at the outer sides, till the whole bed grounds. In the same way other beds are sunk on the top, breaking joint and diminishing in width to above low water, when the rest of the work can be laid by hand and brought up to the proper level.

EROSION PROBLEM SOLVED AT REASONABLE COST.

The last part of the problem, the guarding against erosion by waves, can thus be solved at a reasonable expenditure. Then remains the defence against the currents, which consists in keeping them as far as possible from the foot of the dams by groynes. The choice of materials to be employed is ruled in the same way as in the case of the dams. It is principally a question of cost. But massive dams are liable to have their seaward ends underscoured, often not perceived till too late, leading to complete destruction. Timber groynes have the advantage of being more easily moved should it be found that they do not answer their purpose where they stand, but, being exposed to the buffeting of the waves on both their sides, they require more constant repairs than pile rows parallel to the coast line.

[illegible] estimates over work enters to a great extent in the construction of these groynes.

The cost of the sort of work depends much on local circumstances, like all enterprise in connection with the sea, but an average price is from five to six shillings a cubic yard of contents.

[illegible] read before the Civil and Mechanical Engineers' Society.

NEWS ITEMS.

[illegible] prize distribution by Lord Stalbridge to the students of the Mechanics' Institute, Crewe, Sir Oliver Lodge in an address emphasised the importance of the study of pure science.

Messrs. William Beardmore and Co., Ltd., are making extensive additions to their works at Parkhead. The firm have for some time been laying down plant for the manufacture of guns of all sizes and types.

Mr. Bennett H. Brough, A.R.S.M., F.G.S., F.I.C., F.C.I.S., will deliver an illustrated lecture on "Mining in Ancient and Modern Times" to the members of the Chartered Institute of Secretaries, at the Memorial Hall, Farringdon Street, E.C., at 8 p.m., on Wednesday, December 6th.

The Spanish Minister of War introduced in the Cortes last week a Bill authorising the purchase from the Creuzot factories of 200 quick-firing guns with the necessary material. A vote of £840,000, spread over four financial years, will be appropriated to defraying the cost of the new armaments.

Producer gas enterprise in the Birmingham district is causing the gas committee very anxious consideration. The quantity of gas supplied by the department for use in engines is approximately 960 million cubic feet per annum, or about 15 per cent. of the total quantity sold during the year ended March 31st, 1905. The effect of the recommendation contained in the last report presented by the committee to the Council was to secure to users of smaller quantities of gas for power purposes reductions in price from 2s. 6d., 2s. 3d., and 2s. to 1s. 10d. per 1,000 cubic feet and no reduction was then made in favour of the larger consumers of gas for motive power. The committee having examined the position from all points of view, are of opinion that the price of gas for motive power should be further reduced, and therefore recommend that from and after the Christmas quarter index reading of the meters, the following charges shall be made for gas used exclusively for motive power purposes:—On consumptions in one premises of under 100,000 cubic feet per quarter, 1s. 10d. per 1,000 cubic feet; over 100,000 cubic feet per quarter, 1s. 7d. per 1,000 cubic feet, less the usual discount of 5 per cent. for prompt payment.

IRON ORE DEPOSITS ABROAD.

POSSIBLE FIELDS FOR FUTURE ENTERPRISE.

[illegible]

[illegible] with those of other countries has been presented to the [illegible] Professor [illegible] of the Swedish Geological Department. It admirably summarises the information given in this journal recently, [illegible] given on page 1212 shows at a glance the iron ore supply of the world, the principal known deposits being starred.

Besides the above enumerated principal ore bodies [illegible] exists all over the world, and special mention is made of the ores of Algeria, Soudan, Kameroon, India, Turkey, [illegible]ba, Mexico, Utah, Oklahoma, Newfoundland, New [illegible]ledonia, Western Australia, Ireland, and North China (where in the Province of Shansi specially rich ores are [illegible]).

TOTAL FOR ALL COUNTRIES.

[illegible] are given the quantity, in round numbers, of the estimated known workable ore bodies, and the present annual product, consumption, and exportation of iron ores of the leading iron producing countries in the [illegible].

	Workable [illegible] Million [illegible]	Present annual output. Million tons.	Present annual [illegible] Million [illegible]	[illegible] annual exportation. Million [illegible]
United States..	[illegible]	[illegible]	[illegible]	[illegible]
Great Britain ..	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Spain ..	[illegible]	[illegible]	[illegible]	[illegible]
Russia and Finland .	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Hungary	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Totals	[illegible]	[illegible]	[illegible]	[illegible]

The world's iron requirements, which in 1800 were only about 2,000,000 tons, have since increased by leaps and bounds, as is seen from the following table showing the world's total pig-iron production during each quarter of the century :—

	[illegible]	[illegible]	[illegible]	[illegible]	Million tons. Totals.
Great Britain ..	8	40	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Germany ..	2	7	23	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	770	[illegible]

REQUIREMENTS OF THE PRESENT CENTURY

[illegible] and waste it has been estimated that the corresponding ore consumption up to date has totalled 3,300,000,000 tons, and as last year's pig-iron production reached nearly 50,000,000 tons, the present annual ore requirements must be from 100,000,000 to 150,000,000 tons. At the present rate of consumption, therefore, at least 10,000,000,000 tons of iron ore, or the whole stock in sight, would be required before the end of the present century. By allowing for the increased consumption at the rate of the increased output during the last 30 years, Mr. Hadfield, in his presidential address before the Iron and Steel Institute in May last, arrives at the conclusion that 45,000,000,000 [illegible] will be required during the present century.

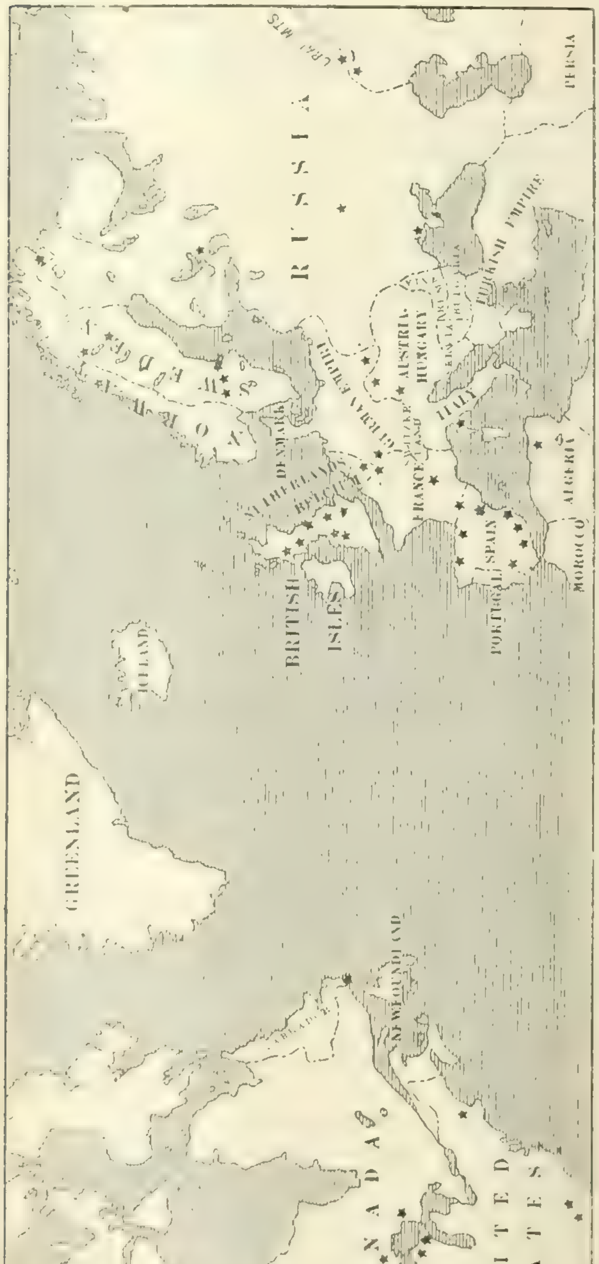
[illegible] have long been known, with the exception of the [illegible] The Swedish [illegible] are without exception old discoveries. The present English iron mines have all been opened up within the last 60 years, and of the American lake ores, the Marquette range, the oldest, was opened up in 1854.

With the above facts in mind, and considering the diligent exploration work lately going on all over the civilised world it appears questionable if the new iron discoveries will more than suffice for the increased home consumption which generally develops with the advance of civilisation and the settlement of a new country. Nature's iron supply will probably never be exhausted, but the iron and steel industry will long before the end of the present century undoubtedly have to depend upon and be compelled to utilise many bodies of ore now considered of too lean and inferior a quality for furnace use. This will be made possible by means of roasting and improved concentrating processes, by [illegible] returning which [illegible]

[illegible]

CONCLUSION.

In conclusion, Professor Törnebohm makes certain predictions as regards the probable development of the future iron industry, the principal ones being as follows:—



MAP SHOWING KNOWN IRON ORE RESOURCES OF THE WORLD, THE CHIEF DEPOSITS BEING STARRED.

1. The ore fields of the present large producing countries, namely, North America, Great Britain, and Germany, will be exhausted within one or two centuries, and the higher grade ores much earlier.

2. The future centre of the iron industry will, as now, be located where natural fuels abound, "as the ore travels to the coal, and not *vice versa*."

3. As a consequence, Great Britain, whose coal supply, it is estimated, will be exhausted within 250 years, will thereupon cease to be an iron producing country, while the United States and Germany, with their much larger coal areas, the iron industry will continue, although being dependent upon imported ores. For the same reason North China, where iron and coal are found associated together, [illegible] upon [illegible] promising iron centre.

To [illegible] paragraph Professor Sjögren takes strong exception, contending that the fallacy of this dogma has long been proved, and that the great iron industry depends on other factors fully as important as the fuel question, such as the extent, richness, and purity of the ores, freight charges for ores, coal and iron products, traffic regulations, etc., and as instances where the "ore does not go to the coal" the following iron-making centres are quoted:—

Styria, with excellent iron ores, but fuels imported from Westphalia and Moravia.

Luxemburg district, with cheap easily reducible ores and a good home market, but fuel imported from Belgium and Westphalia.

Bilbao, where pig-iron is produced cheaper with native ores and imported coke than either in Cleveland England, or Westphalia or Liége, or in the Loire district in France.

New Jersey, with rich native magnetites and an excellent home market, but depending upon Pennsylvania coke.

Portoferrajo on Elba, and Piombino, Italy, depending upon the Elba ores and a protective Government.

Cockerill, Seraing, in the centre of the Belgian coalfields, having established steel plants near Bordeaux, France.

Schneider and Company, Creusot, situated in the [illegible] the French coalfield, having [illegible] works at Cette [illegible] the Mediterranean.

[illegible] the Kraft [illegible] near Stettin, and the new iron works near Lubeck.

OUR WEEKLY BIOGRAPHY.

PROFESSOR ARCHIBALD CAMPBELL ELLIOTT, D.Sc., M.Inst.C.E., M.I.Mech.E.,

Vice-President of the Institute of Marine Engineers.

The University College of South Wales and Monmouthshire, a constituent college of the University of Wales, has given to the engineering world many young engineers whose careers are full of promise—some, indeed, have already attained no small degree of prominence, a notable instance being that of Mr. W. H. James, B.Sc., probably the most distinguished product of the Cardiff school, who is now one of the professors of the University of Madras. It is well known that the percentage of successful engineering students in the new Welsh city is very high—a fact which reflects the greatest credit on the professional ability of the occupant of the chair of engineering.

Born at Glasgow in 1861, Dr. A. C. Elliott received his primary education at Anderson College, and afterwards passed through Glasgow University to that of Edinburgh, where in 1885 he graduated B.Sc., and three years later took the higher degree of Doctor of Science in Engineering.

PROFESSOR ARCHIBALD CAMPBELL ELLIOTT, D.SC., M.INST.C.E.

In 1876 he entered as a pupil the engineering department of the Glasgow and South-Western Railway; upon completion of his indentures he was made a member of the staff.

In 1882 Dr. Elliott was associated with Professor Fleeming Jenkin, engineer for the Commercial Cable Company's undertakings, and assisted him with his schemes of automatic electric transport. About this time he also served under Lord Kelvin (then Sir William Thompson), and in 1885 was appointed assistant to the professor of engineering in the University of Edinburgh, which position he occupied until selected for the Cardiff chair of engineering. He is a member of the council of the South Wales Institute of Engineers, and in 1899 served on the Royal Commission on accidents to railway servants. Professor Elliott is the author of various papers on professional subjects.

TECHNICAL SOCIETY NOTES.

An interesting lecture was delivered on Saturday last at the rooms of the Leeds Association of Engineers by Mr. Robert Buchanan (president of the British Foundrymen's Association) on "The Melting and Cooling of Cast-iron." If no other change took place, he said, in the melting of metal except that due to mixture, foundry work would be much simplified. But the need was becoming daily more urgent of knowing how to mix cast iron so as to make it suitable for the purpose required and of understanding how the result was brought about. The purchase of iron by analysis was spreading, bringing its reward to the initiated. A sample of hematite iron recently tested was found to contain 0·22 per cent. of sulphur—enough to ruin any casting. His own method of mixing on the basis of analysis included the deduction of 0·10 per cent. of manganese, and 0·25 per cent. of silicon. lost in one melting, and the addition of ·038 per cent. of sulphur gained. The gain of sulphur in each melting was prohibitive of large quantities of scrap, as with over ·1 per cent. the castings would be difficult to machine. Mr. Buchanan went on to show the effects produced by chemical combination resulting from the admixture of various irons by magnifications of the surface markings thrown upon the screen. The processes of combustion in various types of cupola, notably in the Mackenzie, Whiting, Greener, Herbertz, and Thwaite cupolas were explained, also the difference in the result of slow and rapid cooling and the effect of annealing. Melfing on the basis of analysis, said Mr. Buchanan, was the only certain method, and when once results were arrived at, the work of any one man could be taken up where he might [illegible] by his successor.

The young engineer is no doubt in need of occasional encouragement, if only to save him from the folly of imagining that there are few fields left for him to conquer. Mr. Donald A. Matheson, the engineer in-chief of the Caledonian Railway Company, evidently had this in mind when addressing the Glasgow Association of Students of the Institution of Civil Engineers recently. Dealing with the work of railway engineers in the future, Mr. Matheson indicated that the tendency was in the direction of betterment by the widening of existing lines—rather than in the construction of new railways—the providing of additional accommodation, and the extension and improvement of the great terminal stations for goods and mineral traffic, as well as for passenger traffic in the principal cities of Europe and of the United States. In New York City alone, at the present time, money to the amount of something like twenty million pounds sterling was being expended in the providing of improved terminal station accommodation. The single line mileage of railways in the United Kingdom had been increased by 3,000 miles in the past decade; Scotland's share being 550 miles, and there were signs that much railway work still remained for civil engineers to execute. In Canada and the United States, especially, the new railway field could be described as practically illimitable. It was the same in other branches of the profession, there being no indication of finality in the construction of water works, drainage works, dock works, etc., so that it was encouraging to the young civil engineer to know that in respect of commercial enterprise and relative civil engineering work the immediate future promised to be quite as prolific as the past. There was also the pressing question of rapid transit in large cities and suburban districts to be dealt with, involving immense interests, and presenting engineering and economic problems the solution of which had been the special study of some of the most eminent civil engineers of the day.

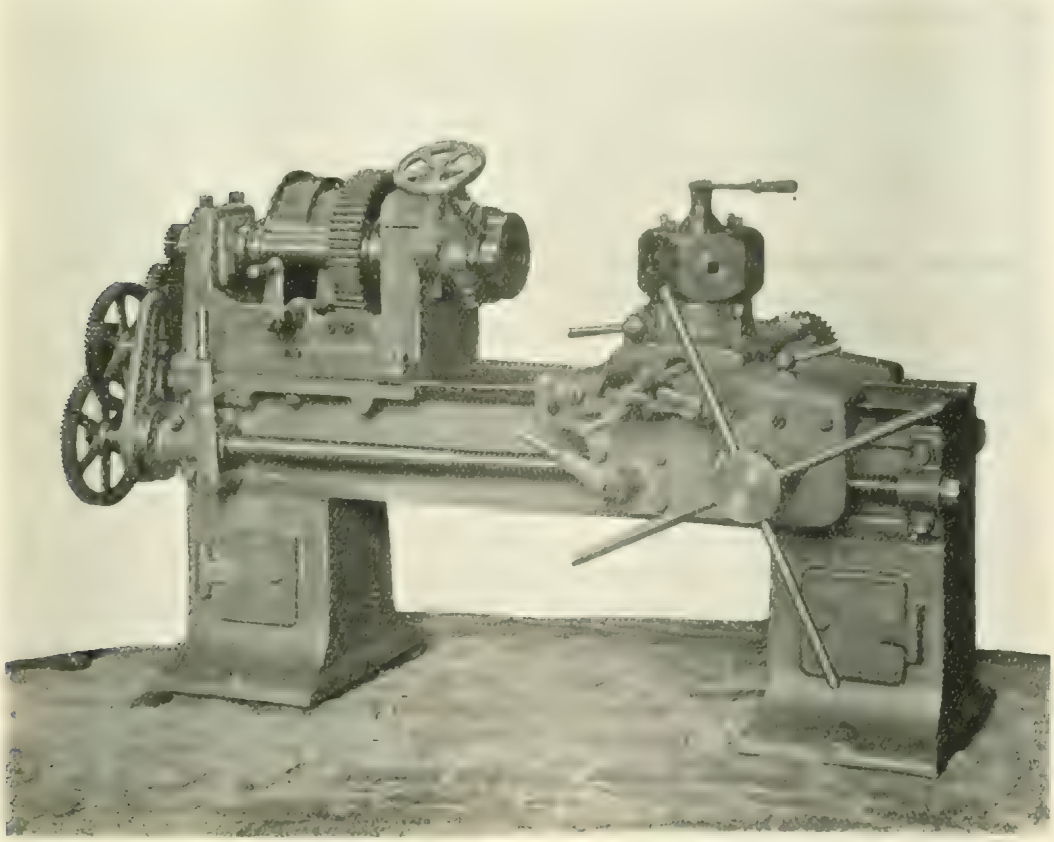
Physicists generally attempt to deduce the dielectric strength of air, at a given barometric pressure, from the results of experiments on the disruptive voltages between equal metal electrodes at given distances apart. They calculate the maximum value of the electric intensity between the metal electrodes on the assumption that the electric field round them is similar to that existing at low voltages. Lord Kelvin, however, as far back as 1860, deduced from the results of his experiments with large electrodes that it was "most probable" that the numbers obtained in this way at higher voltages would be "sensibly constant." An examination of many of the results obtained recently by electricians will show that experiments has amply justified Lord Kelvin's conclusion. Mr. Alexander Russell, who read a paper on the subject, before the Physical Society last Friday, states that by considering experimental results obtained both with direct and alternating pressures, the limiting value to which the numbers approach [illegible] kilovolts per centimetre.

10-in. CAPSTAN LATHE FOR SHELLS.

BY HY. BROADBENT, LTD., SOWERBY BRIDGE.

We illustrate below a special screw-cutting capstan lathe, with 10-in. centres, built by Hy. Broadbent, Ltd., of Sowerby Bridge, for the manufacture of shells. The bed is 5 ft. 6 in. long, being 15 in. across top surface, and is supported on two cabinet feet. The fast headstock is provided with a steel centre spindle, running in gunmetal parallel bearings. The machine is driven from a four-speed cone pulley on shaft at the back, and is geared up 4 to 1. On the front end of the running spindle is carried a chuck for gripping the work made with cones to hold the shell.

The latter is retained by an outer cap, which is slackened and tightened by a worm wheel. The saddle carries a hexagon turret 9½ in. across the flats, with 2-in. holes bored right through each face and provided with locating pins and locking bolts. The saddle is also self-acting, sliding, and surfacing from the back shaft in two rates operated from a hand lever in front of the headstock. These feeds are reversible from the front of carriage. Quick hand motion along the bed is also furnished. Screw-cutting motions are also added with lead screw, two per inch, and change gears to cut fourteen threads per inch. The lathe is provided with full set of top driving apparatus, etc., and weighs approximately 30 cwt.



SPECIAL CAPSTAN LATHE FOR SHELLS.

DESTRUCTORS AND THEIR BY-PRODUCTS.

By E. L. Watson, Assoc.M.Inst.C.E., M.I.Mech.E.

ALL refuse should be collected from covered bins at least once or twice a week, and if it were done every day it would be all the better. But, having collected the material, how is the public authority to deal with it? The only complete answer to this question is the cremation of the refuse in as complete and rapid a manner as possible.

Some years ago it was considered that the burning of refuse in a destructor was necessarily productive of noisome smoke and smells, and many destructors still exist which are only to be regarded as relics of the past. The constant pressure of sanitary officials has however, resulted in the devotion of a great deal of scientific effort and mechanical ability to the evolution of the modern destructor, and it is now possible to obtain destructor plants in which the suppression of nuisance from smoke, smell or dust, is, for all practical purposes, complete.

FEATURES DETERMINING ECONOMY.

Having resolved on the disposal of rubbish by burning, the great question is, how can the greatest economy be secured? The chief factors which determine the economy of a destructor plant are eight—three of expenditure—(1) cost of labour and supervision; (2) cost of maintenance of plant; (3) capital charges; and five of revenue—(4) value of steam produced; (5) value of clinker after due treatment; (6) returns from other residuals, such as old tins; (7) charges paid by traders for the destruction of trade refuse; (8) manufacture of manure from fish, where this can be collected separately.

It will be observed that these factors vary greatly in different districts, and will depend on the [illegible] plant, the nature of the refuse, the local price of coal, the possibility of a good market for clinker products, and other circumstances.

A much discussed question is the combination of destructors and electricity stations. The first reason in favour of that combination is that, as a rule, an electricity undertaking is the only municipal enterprise which demands sufficient power to take up the whole available steam from a destructor; and the second is, that an electricity station is usually near the centre of population to save loss in transmission, and a destructor is, or should be, near the centre, to save cartage.

SCHEME OF COST.

I will now submit an ideal balance-sheet for a town of 120,000 inhabitants; and I shall assume that the plant is well designed and economically managed, and that all the steam is used, all the clinker made into bricks, and sold at 25s. per thousand at the works, and all the other residuals made as much use of as possible. All my figures will be based on actual experience, but I do not represent that they are all at present obtained in any one town. I have picked out the best results from several towns, and put them together to show what can, and ought, in favourable circumstances to be achieved; but as the brick business is merely in its infancy the figures I have shown from that are estimated. There should be no difficulty in finding a constant market for bricks like these, as the quality is undoubtedly superior to anything except the very best pressed clay bricks.

The value of the steam alone is, if fully utilised, sufficient to pay all the costs of labour on the plant, and something over. I have allowed for ample labour, more than is found necessary in many cases, and for high rates of wages.

In taking the steam at 1s. 0d. per ton I do not think I exaggerate. Coal which will evaporate 10 lb. of water per lb. of coal cannot often be bought under 14s. or 15s., which gives the value at once without taking into account the labour of stoking the boilers, and the interest, repairs, etc., on boiler plant.

The balance sheet below shows a net profit of £2,038 per annum, or practically 10 per cent. on the capital, in addition to the provision made for interest and sinking fund.

It will be noted that I have made ample provision for repairs and maintenance—the sum stated being in excess of actual experience. If it be asked why no existing plant can show such a result, I reply that in no existing plant is utilisation of residuals carried to the length sketched out in my balance-sheet.

With regard to the construction of destructors themselves, the various designs differ principally in the methods of feeding, the methods of taking off the gases of combustion, and the methods of applying forced draught to the furnaces.

METHOD OF FEEDING.

The simplest and most primitive method of feeding is the "front-feed." In this system the furnace has only one door into which the refuse is thrown by the shovel, and from which the clinker is withdrawn when necessary. This system is very suitable and convenient for small plants where the cost of labour is of no great importance, and it has had a very considerable vogue, even for large plants, in cases where high steam-raising results have been considered more important than cost of labour or other considerations. This system lends itself readily to the "spoon-feeding" of a furnace, which, in the case of coal-fired boilers as well as of destructors, is productive of a maximum rate of evaporation, but not necessarily of final economy. The "front-feed" system has the disadvantage that the amount

LIABILITIES.

	£	s.	d.	£	s.	d.
Interest and Sinking Fund on Land, 1500 yards at 10/-	750	0	0			
Interest on Destructor Plant ..	16000	0	0			
" on Clinker Brick Plant ..	3250	0	0			
6% on	20000	0	0	1200	0	0
Labour, viz.:						
Destructor Men, 15 at 30/- per week	22	10	0			
Foreman & Enginemen, 3 at 36/- "	5	8	0			
Boiler Attendants 3 at 24/- .	3	12	0			
Labourers & Brickmakers, 9 at 24/- ..	10	16	0			
Clerical work— 2 at 25/- "	2	10	0			
1 at 24/- "	1	4	0			
Total per week ..	46	0	0			
Total cost of Labour per year ..				2392	0	0
" General Repairs and Renewals ..	1000	0	0			
" Water	200	0	0			
" Oil, Tallow, Waste, etc	30	0	0			
Rates and Taxes, say	250	0	0			
Coal and Coke	25	0	0			
Insurance	25	0	0			
Printing, Stationery, Sundries ..	140	0	0			
Lime—1200 tons at 15/-	900	0	0			
				2570	0	0
" Balance—nett Profit				2038	0	0
				£8200	0	0

ASSETS.

	Tons	£	s.	d.
By [illegible] of Trade Refuse, charged to [illegible] per load .. .		[illegible]		0
" Sale of Old Metal, Tins, etc. .. . . Hammerton Street, Bradford		[illegible]		0
" Dried Fish Manure . .. . Hammerton Street, Bradford		[illegible]		0
" 4,000,000 Bricks [illegible] Clinker [illegible] Lime, at [illegible] per 1000 (Produced by 36 tons Clinker and 4 tons Lime per day)		[illegible]		0
" Steam produced per day .. [illegible]	150 [illegible]			
[illegible]		[illegible]		
		£8200		

AN IDEAL DESTRUCTOR BALANCE-SHEET.

refuse and the clinker have to be dealt with on the same floor, and there is always a risk of getting the two articles mixed up.

BACK-FEED SYSTEM.

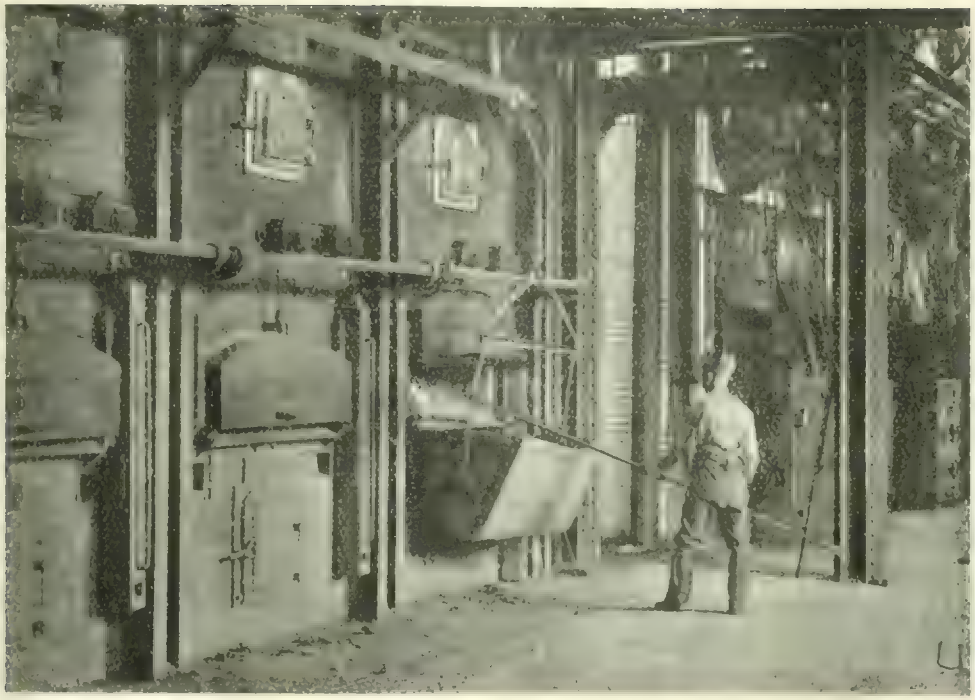
The "back-feed" system has been applied in many successful installations and has been adopted by various makers. It appears to me to possess every advantage which may be claimed for the "front-feed" system, and some additional advantages. In the "back-feed" system the refuse is stored in a convenient bin, which may, if desired, be enclosed to form a hopper, at the back of the cells away from the heat of the furnaces, and at a level which may be most conveniently arranged for easy charging. The refuse is thrown into the furnace by the back door and the clinker is withdrawn from the front. The grate and drying hearth may be conveniently sloped so as to facilitate both the charging and clinkering operations. It will also be apparent that the height of sill convenient for throwing refuse in is not the same as the height most convenient for drawing clinker out. With "front-feed" cells a compromise has to be arrived at, but with "back-feed" cells the sills of charging doors and clinkering doors may each be fixed at the most convenient height above the respective floors.

TOP-FEED SYSTEM.

The "top-feed" system is also one which has enjoyed and still enjoys a very large measure of popularity, and has been adopted with more or less success by, I think, all the different makers of destructors. In the most usual form of "top-feed" destructors a floor is provided on the top of the furnaces on which the refuse is tipped, and feed holes of various forms are arranged so that the refuse can be pushed or shovelled by hand into the furnace. "Top-feed" furnaces are frequently arranged back

36-CELL HORSFALL PLANT AT HAMBURG.

The Largest Destructor in the world. The power is not as yet fully utilised, [illegible] I.H.P. being employed.



FULHAM DESTRUCTOR (12 CELLS).

Daily capacity 120 tons. The cells are fed from the top by hand. The destructor supplies about 600 H.P. for electric lighting, etc.

to-back, or in double rows, thus economising space and keeping the whole plant more compact. The charging holes are sometimes closed by lids, and sometimes, as in the furnace illustrated, by packing the refuse into the feed hole, whose form is arranged to permit of this being done.

METHODS OF CHARGING.

It will be observed that on all these methods of feeding, a provision is made for the storage of a certain quantity of refuse, and this is always necessary, because a destructor must work with strict regularity if it is to be successful, and the collection and cartage of refuse is usually arranged to be done in the shortest number of hours per day, and cannot very well be changed about to suit the requirements of the destructor.

The methods adopted for handling coal and other dry and homogeneous materials have possessed a fascination for a good many designers of destructors, who found to their cost that refuse cannot be manipulated in the same way. It would solve a great many difficulties if ordinary town refuse could be stored in a large hopper tapering towards the bottom, and having a door out of which it may be permitted to flow when required, exactly as is done, in the case of the storage of coal for gas works, and boiler purposes, and of calcined ore, etc., in ironworks. Unfortunately, even with the best of arrangements, a piece of matting or oilcloth, or a large can coming through with the refuse is sufficient to cause a block and stop the whole business; and we must, therefore, reckon with the ascertained fact that refuse will not flow as a dry material will.

It is, undoubtedly, a great advantage to get rid of handcharging altogether, and this has been done with some success in several plants. I have a diagram of one method which has been adopted at Westminster and at Blackpool, and with some modification at Bromley. In this arrangement, the refuse carts tip their load bodily into the furnace, on arrival at the destructor. A door is provided large enough to permit this, and sealed by dipping into water all round its edges when closed. When the door is opened a movable hopper fits into the opening so that the refuse does not fall into the water trough. The arrangement works very well and is remarkably clean and wholesome for the workmen. The one difficulty it presents is that of storage, and in the instances mentioned this difficulty is got over by providing sufficient spare carts to stand full at the destructor until required.

ANOTHER METHOD.

For larger plants another system of storing has been devised, which is being erected on a small scale for the Leeds Corporation, and is also under construction in St. Petersburg, and will shortly be erected at Newcastle. In this arrangement the place of the spare carts is taken by a series of storage tubs having self-opening bottom doors, which are held closed by means of lifting chains. Into these tubs the carts tip their loads on arrival at the destructor. The tubs are lifted by an overhead travelling crane, and stacked full until required. Each tub holds a full charge for a furnace. In charging a furnace the tub is lifted by the crane and placed on the top of a movable hopper, which is caused to descend by the weight of the tub. The water-sealed door is connected to the hopper by an arrangement of rods and levers, and is thus automatically opened by the descent of the tub, and in the same way automatically closed when the tub, after being emptied, is lifted clear by the crane. It is too early yet to say much of the results which will attend this method of charging destructors, but it has been considered to promise sufficiently well to justify its construction under

EXTERIOR VIEW OF 4-CELL DESTRUCTOR PLANT AT LOWESTOFT.

The destructor burns about 40 tons of refuse per 24 hours, and is a good example of the "back-feed" style of plant guarantees. It will in large plants effect a considerable saving in the cost of labour, and this will be sufficient to justify the capital expense of the additional machinery involved: it is not, however, suitable for small plants. For capacities up to 60 or 80 tons per day I do not think anything will be found superior to the ordinary "back-feed," the ordinary "top-feed," or the Bromley "cart-feed" system, either of which may be adopted according to circumstances.

THE GASES OF COMBUSTION.

As regards taking-off the gases of combustion, there are, speaking broadly, three methods in use. The first and most primitive involves drawing off the gases at the back of the furnaces. This answers quite well with "front-feed" cells, but if adopted with cells which are fed from the back it results in unburnt gases and smoke passing away to the flue.

The next method to be considered is that by which the gases from one cell, or "division," of the destructor (for in this system the destructor can hardly be said to have any cells) are carried into the next division, and so on to the end of the battery. The last section of the battery has thus to carry through the whole of the gases from the plant, which makes it pretty warm for the stoker at that end. Furthermore, there does not appear to me to be quite the same certainty of perfect combustion in the last section as there is with cellular systems, and it is not possible to repair any one section without stopping the whole plant. For these reasons I should not advocate this system except for small plants, and if adopted for large plants I should consider it necessary to divide them up into small batteries.

The next system is that in which the outlet flues are situated towards the front of the

PART OF THE 24 CELL HORSFALL PLANT AT BRUSSELS.

Burns 200 tons of refuse per day. Surplus power is used for the cranes which lift the refuse to the top of the furnaces, and for lighting and other purposes.

furnaces, and are connected by cross flues with a common combustion chamber, in which all the gases mix before passing to the boilers. This system, which was originally invented by Mr. William Horsfall, of Leeds, has been adopted very largely, and is now used by several of the best known markets. The system ensures a perfect mixture of the gases at all times, and enables each cell to be repaired independently. The course of the gases from the grate to the boilers is a trifle longer with this arrangement than with that in which they pass from one section to the next and so on, but this is, in my opinion, more than counterbalanced by the other advantages of the system.

FORCED DRAUGHT.

To come now to the different methods of applying forced draught. We have strenuous advocates of steam jet blowers, and equally strenuous advocates of dry air blast by means of a fan. The fact is that both these methods have their advantages, and each is specially suitable for particular cases. Steam jet blowers are frequently accused of being very wasteful in steam, but as they have been tested down to 10 per cent. of the steam raised, I do not think that fan draught can show a much more economical result than that. For refuse containing large quantities of carbon, the injection of steam with the air has an advantage in the production of water-gas in the lower part of the fire, and the carrying of the combustion to a point further on in the furnace, and the production of a longer flame. It also assists in preserving the grate bars. Fan draught on the other hand seems specially suitable for refuse which is chiefly of a vegetable character, and when suitable fans or blowers are used, it is possible to get a very much higher blast pressure than is practicable with steam jets. If a system of feeding be adopted which will enable very large quantities of refuse to be charged into the cell practically instantaneously, there is going to be a great advantage from an increased rate of combustion; and in such plants I have no doubt that fans will be the most successful. For smaller plants I consider that steam jets, if well designed and properly made, will hold the field for a long time to come.

There is a considerable advantage from heating the blast for destructors, and this has been done in various ways. In some cases an air heater consisting of a stack of pipes fixed in the flue at the back of the boilers, is used, through which the air for combustion is drawn by the blower or fan. The rise of temperature obtained by this means, though undoubtedly valuable, cannot be very great unless there is a big waste of heat from the boilers.

Another system is to deliver the air through cast iron side boxes, fixed in the furnace sides, which boxes are kept hot by their contact with the clinker and burning refuse, and at the same time these boxes give a protection to the brickwork of the cell against destruction by clinker. An ashpit temperature of 400 deg. F. to 600 deg. F. can thus be obtained, which must very materially assist combustion.

FURNACE CONSTRUCTION.

In furnace details great improvements have been made and it should particularly be mentioned that all doors should fit tightly on planed faces to prevent the escape of gases or the inrush of cold air, and modern high temperature destructors require to be very strongly stayed. The furnace linings must also be constructed of the best fire bricks, or their life will be short.

It must be remembered that in a good destructor, properly worked with forced draught, the connecting flues and combustion chamber, as well as the inside of the furnaces will be maintained at a constant bright red or nearly white heat, and it should be the aim of a destructor foreman to see that the heat is never permitted to drop while the plant is at work.

It is very largely a question of perfectly regular stoking and of the proper adjustment of the chimney pull and the forced draught.

The strong chimney pull will at once [illegible] the temperature and the air should be [illegible] with the least possible draw over the fire practically a plenum in the furnace itself. It will also reduce to a minimum the amount of dust carried out of the furnace, which is most marked when a very strong chimney draught is used.

BOILERS.

As near as possible to the furnace combustion chamber should be fixed the boiler or boilers which are to utilise the available heat. For every 10,000 inhabitants there is roughly 10 tons of refuse per 24 hours, and this is capable of producing over 50 h.p. if properly utilised. Therefore the boilers are a most important item, and they should be properly proportioned to the plant. They may be of any of the well known types, but the water-tube boiler is generally the most convenient, and I think the most efficient.

DUSTCATCHER.

After the boiler, in all but the smallest of plants, a dustcatcher should be fixed. The most widely known form of dustcatcher is on the centrifugal principle, the heavier particles of dust being separated from the gases by centrifugal force while the gases are passing rapidly round the interior of a circular annular chamber. The dust is collected in external pockets attached to the chamber. It has been found that such a dustcatcher is capable of arresting over 98 per cent. of the total dust contained in flue gases. The material collected in the dustcatcher is extremely fine, sharp and clean, and is used for various purposes, one of the most important being as a base for disinfecting powder.

From the dustcatcher the gases pass to the chimney, and this need not in most cases be of any great height. The old fashioned chimneys were only necessary for old fashioned low temperature destructors. With a modern destructor, unless the situation is very exceptional, a chimney from 60 to 90 feet in height is all that is necessary.

MORTAR MANUFACTURE, ETC.

One could almost fill another paper with descriptions of the various machinery for the production of mortar, crushing and screening of clinker, the convenient removal of clinker from the front of the furnaces, and the manufacture of clinker bricks and of concrete flags, etc. All these machines have been made the subject of deep study, and may be obtained specially adapted to destructor work.

With regard to the buildings surrounding the plant, these should, as far as financial considerations will permit, be ample in size, lofty, well ventilated, and lighted from the top, and the openings for wheeling out clinker, etc., should be provided with doors, in order to prevent the draughts which are frequently troublesome in destructor houses, causing dust to blow about and get into people's eyes and throats.

Generally, it may be said that when all proper precautions have been taken in the construction and working of the plant a destructor is a source of no nuisance whatever, and the only inconvenience of which the neighbours could possibly complain is that due to the carting of the refuse through the streets. Even that can be reduced to a minimum by the use of proper carts and by proper attention to cleanliness. In numerous instances dwelling houses have been built in large numbers close to an existing destructor after the latter has been at work, and I remember one instance in which the owners of some property near a proposed destructor, after attending at the Local Government Board inquiry and raising all the opposition of which they were capable, proceeded as soon as the plant had been erected to acquire more land and construct more houses much closer to the plant than those which they originally possessed.

MANAGEMENT.

We now arrive at a matter of great importance to electrical engineers—the allocation of costs and returns as between the destructor and the electricity works and the management of the joint undertaking.

If the cleansing department runs the destructor and sells steam to the electricity department, it will be run for sanitary purposes, and may not give its maximum results when the electricity department wants them; if by the electricity department, it may be run for steam regardless of sanitary considerations; again, if the sanitary department is to be paid for steam, how is the quantity to be ascertained? I know of no satisfactory method, since the quantity used in the destructor itself is generally more or less uncertain. The value of the steam per ton is easily ascertained from the cost of raising the same quantity by means of coal. The ideal method would appear to be to drive an independent generating set from the destructor, and to work this set as near as possible at a constant load, crediting the destructor with the actual output. If the generating set can also be retained in the control of the cleansing department, and the current delivered by meter to the electricity department, it is better still. A very well-known city surveyor said recently that most of the electricity generated by destructors was produced by friction between the two departments; and, if that be so, it is deplorable that the ratepayers' money should be so wasted. If we take the Sunbridge Road plant, for example, we find that 50,000 units per week, for fifty weeks at 1d. per unit, represent £1,050 per annum, which is a very considerable saving, and one that ought surely to be carried into effect.

Perhaps these questions may find a solution in the increasing responsibilities undertaken by cleansing departments, such, for example, as the combination of a works department for the whole corporation, the manufacture of clinker products, and the lighting of stables, workshops and staff dwellings, and streets in the vicinity of the plant, or the sale of power to neighbouring manufacturers.

From a paper read before the Leeds Local Section Institution of Electrical Engineers.

THE RESULTS OF TECHNICAL EDUCATION IN ENGINEERING.

By JOHN GOODMAN, M.Inst.C.E.

TECHNICAL education consists mainly in training students to regard the everyday problems of their profession from a scientific standpoint. The meaning attached to the term "scientific" is of importance. The province of science is (1) to ascertain facts gathered from various sources far and wide, (2) to classify such facts, (3) to find some general law or formula which shall sum up briefly the results of such classification, and enable us to predict the result of any new combination of circumstances in the future, and (4), to apply such general laws or formulas to new problems as they arise.

A technically educated engineer is keenly alive to the importance of side issues, and is constantly on the alert in making observations, collecting and classifying all data that will enable him in the future to adjust his formulas to fit practical conditions. Once having acquired the scientific mental attitude he will ever be on the alert for knowledge and for data to throw light on the problems that confront him: it is this mental attitude that technical teachers aim at imparting to students.

Those therefore who have acquired this attitude, gain experience much more rapidly than those who have not had the advantage of a technical training. This capacity for rapidly gaining experience is believed to be the most important result of technical education; in short, it teaches students to *observe* as well as *see*.

The idea that technical education consists merely in committing to memory a vast array of facts and "trade tips" is entirely fallacious.

THE RESULTS OF TECHNICAL EDUCATION AS REGARDS ENGINEERING STUDENTS.

The aim of technical education is (1) to train the mind to deal systematically with any question or [illegible] that [illegible] to [illegible] points at issue after dismissing all irrelevant matter ; (3) to train the imagination ; (4) to impart the power of observation ; also of analysing intricate mathematical and scientific problems ; and (5) to impart ideas of accuracy and definiteness of expression.

There are some teachers who go to the absurd [illegible] utility ; they adhere strictly to pure science and mathematics in their courses, with the result that they fail to arouse any interest in the majority of their students, whilst the remainder seldom learn to appreciate the necessity of allowing for imperfect data. The students are therefore liable to regard the ideal data of the physicist and the mathematician as the real data of engineering problems as encountered in practice. Students who have been thus trained are, perhaps, in a worse plight than those who have received no scientific training at all.

One little incident will serve to show the extreme views taken by some educational authorities, one of [illegible] does that lose its educational value." There was no uncertain sound about my reply : "As far as the East is from the West, so far are my views from [illegible]

Every engineer who desires to rise high in his pro[illegible] profession demands of him, should aim at acquiring a broader culture than a purely utilitarian training can give. Even specialists should have a general knowledge not only of their profession but of the world and of human life in all its varied aspects and experiences.

THE PROFESSIONAL POINT OF VIEW.

A technical training furnishes a student with a powerful weapon for dealing with original problems. Once having acquired the mental attitude of dealing with every question in a scientific spirit, he attacks his problem with a directness and certainty that are lacking in the untrained man. The mind of the trained man resembles a collection of pigeon-holes, each reserved for some definite class of problem, and his first act on being confronted with a new one is to decide upon the pigeon-hole to which it belongs. The method of attack then becomes clear, and unless the problem is one of great difficulty he readily obtains an exact, or at least an approximate, solution. Contrast this method with the chaos common to many engineering drawing offices, where, instead of grappling with the problem itself, the chief draughtsman gives [illegible] to see if anything of the kind has been done before, and if lucky enough to find an instance bearing some resemblance to that required, it is copied or altered to suit, with the result that either too much or too little metal is probably used, but, worst of all, originality of [illegible]

The writer is fully alive to the fact that in many [illegible] it may entail a considerable waste of metal.

Occasionally, cases arise in which the theory is incomplete, or for other reasons it is not advisable [illegible] course, reference to a previous successful design is not only desirable but is demanded by common prudence. [illegible] however, will [illegible] with his partial treatment so far as his theory permits, but will extract from the successful design the necessary data for a general treatment, utilising this for a direct solution of similar cases in the future.

Compare, now, the two common methods of setting out valve gears. By means of well-known diagrams a technically educated draughtsman of ordinary ability will get out an *exact* solution of any gear, however complex, in a few hours, but in the absence of such a man a model has to be constructed at probably twenty times the cost, and the time taken in its construction may seriously delay other portions of the design.

[illegible] old designs to manage to muddle through when nothing novel or original is expected of them, but how sad their plight is if they attempt to branch forth on new lines may be judged from the following incident. A firm of high reputation undertook to make a very large machine (for stamping sheet metal) of a somewhat unusual design, which was [illegible] cranks, one at each end of a long shaft. But the effort to be overcome by the machine was very variable at times, which caused the machine to pull up dead. [illegible] to the makers to put a flywheel on the crank-shaft, but they agreed to [illegible] it once when one was suggested. A pattern, was found in the stores which was rather larger than necessary, but it fitted in conveniently with the rest of the design. Instead of using the suggested pattern however, they made a solid flywheel or sleeve 20 in. in diameter and 8 ft. long, making as they termed "a nice snug job of it," but to their astonishment the snug flywheel made practically no difference as to smoothness of running, although, as they complained, it was heavier than the one they were advised to use ; the poor "theorist" who advised them to adopt the [illegible] blamed for the failure.

When a blunder of this kind is quoted, the aggressively practical man immediately retorts: Yes, but very foolish blunders are often made by technical men who lack a knowledge of practical matters. Quite so—but such blunders are not due to the man's technical knowledge, but to his lack of practical knowledge. [illegible] advocate of technical education who is worth his salt will contend that a technically educated man [illegible] with practical experience. In the opinion of those who are engineers as well as teachers, the practical training is even more important than the technical, but both are essential to success in the highest [illegible] of the profession.

THE DESTINATIONS OF TECHNICAL STUDENTS.

The question is often asked: What becomes of the large numbers of technical students after they leave college? An analysis of our own students' records for the past fifteen years shows that in after life they [illegible] as follows:

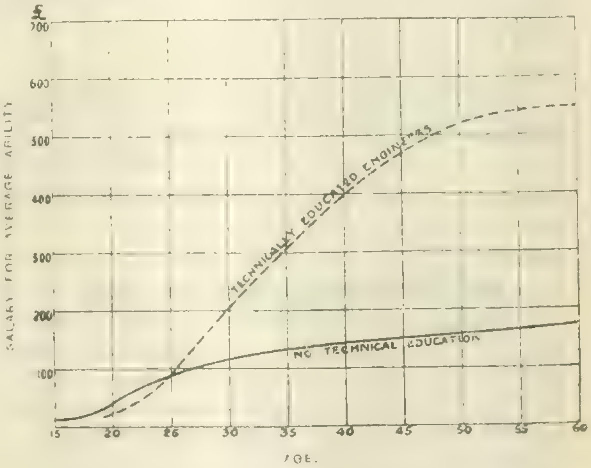
Managers of works and chief engineers	[illegible]
Under managers and assistants	61
Resident engineers on civil undertakings, including engineers in Public Works Department, India	[illegible]
Draughtsmen	81
Station engineers (electrical)	21
Managers, draughtsmen, etc., in their own or their fathers' works	[illegible]
Set up on own account as consulting and manufacturing engineers	14
Teachers	7
[illegible]	[illegible]
Given up engineering	47
Lost sight of	27
[illegible]	[illegible]
Still under training in works and offices ..	40
Taken up architecture, mining, Royal [illegible] surveying, railway [illegible] ..	[illegible]
Total, including about [illegible] students at present attending the University course	415

The [illegible] destinations [illegible] also be of interest:

Great Britain	[illegible]
India and Ceylon	[illegible]7
[illegible]	12
[illegible]	[illegible]
European Continent	7
Canada	4
South America	4
Australia and New Zealand ..	[illegible]
Egypt and the Soudan	2
Japan	[illegible]

Another question of interest is this: Do technically educated students rise to higher positions than similarly placed youths who have not had such a training? Generally speaking, they unquestionably do rise to far better positions, and this by virtue of their technical attainments, although there are, of course, a vast number of cases in which men of little technical or even general education have risen by force of character to very high positions in the engineering world. Given, however, youths of good character and ordinary ability, no one who has even casually looked into the question can deny for one moment that the technically educated youth rises to a much higher position than the one who has not had the advantages of such a training. In order to get some definite data on this question the writer has made enquiries of many former students and of heads of firms who employ both types of men. From such data the curves in the accompanying diagram, Fig. 1, have been drawn, but [illegible] must be clearly understood that they only give the general opinions of those consulted. Assuming the general trend of them to be correct, we see that the youth who spends no time on technical education actually earns more money up to about the age of twenty-five than does the technically educated youth, partly because the former gets about three years' start, but after this age the salary of the latter rises rapidly. In both instances we refer to the case of youths of average ability and industry. It is quite a [illegible] matter

Fig. 1.



[illegible] through technical institutions and yet have utterly [illegible] Such cases are sometimes cast in our teeth as a proof [illegible] who insist on forcing their lads into engineering when they have not the least inclination for it.

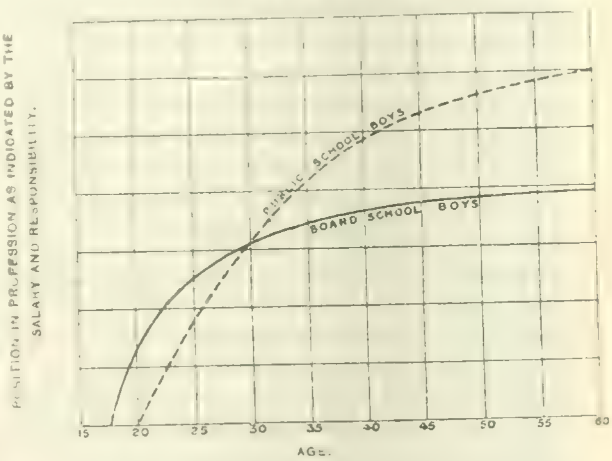
PARENTAL NOTIONS.

[illegible] engineering colleges in the hope that they will there get [illegible] avoid the duty [illegible] part in the works. Others, again, who recognise that their sons lack ordinary intelligence vainly imagine that a technical training will compensate for their deficiencies and so enable them to successfully compete with others of average ability who have not been fortunate enough to get such a training. Needless to say, this is not the stuff that engineeers are made of, yet weaklings of this type are dragged through technical colleges where they rarely succeed in passing an examination, and on leaving they are regarded as "technically educated" by the man in the street, and naturally give rise to sarcastic remarks about the failure of technical education. This state of affairs will continue until colleges refuse to admit such men to their classes. If by chance such a one should accidentally creep in it is plainly the duty of the college authorities to advise the parents that there is no hope of ever making him even a passable engineer.

SCHOOL EDUCATION.

There is yet another matter of great importance in the technical training of engineers: given two youths of the same age and of about the same natural ability one of whom has received a public school education, and the other a board school education, or its equivalent, which will attain to the highest position in after life? In the absence of precise data the answer to this question must largely rest upon opinion, but the result of an analysis of the careers of [illegible] students (about one-third of whom come from public schools, and about the same proportion from board schools), is shown by the curves in fig. 2. Our experience shows very clearly that the board school boy rises more rapidly in his profession at first than does the public school boy, chiefly because much of the former's school time is devoted to studies that pertain to engineering—mathematics, mechanics, chemistry, etc., whereas the public school boy devotes his time to classics and literature, to the neglect of those scientific subjects that would be of direct value to him in his profession. In later life, however, his culture [illegible] with that of similar training. The smart board school boy shoots ahead at first, but he reaches his zenith at a comparatively early age, his lack of polish and culture are tolerated up to a certain point but he rarely reaches the highest positions in the profession. Outside of his strictly professional work, the professional man has to deal with educated men, who will not tolerate him unless he has a fair modicum of culture. When making this comparison, however, it should not be forgotten that the public school boy often has a considerable amount of influence behind him which tells in his favour over and above that due to his superior general education.

Fig. 2.



We do not see any good reason why the advantages of the two school systems should not be combined to the benefit of both—let the public school boys, even on the modern side, devote a little more time to modern subjects and less to classical, and let the board school boys devote a little more time to literature and the humanising subjects than is now the case.

Among the many advantages accruing from a technical education perhaps the most important is that of enabling a man to gain experience, or, we might say, to benefit by his experience, and to make correct deductions from what he sees. Next in importance is his increased capacity of adjusting himself to necessary changes from one branch of the profession to another. This faculty of bringing himself into correspondence with his environment is largely due to the fact that the same fundamental principles underlie every branch of engineering; hence change from one branch to another is simply a matter of picking up detail in the case of the technical man, [illegible] technical [illegible] is a matter of [illegible] profession.

SOME MISCONCEPTIONS.

[illegible] who will not employ men of high technical attainments. They openly state that they prefer draughtsmen and managers who have very little, if any, scientific knowledge of engineering. [illegible] partly due to prejudice and partly [illegible] technically educated men often make [illegible] for one or more of the following [illegible]

[illegible] suffer from swelled heads and are [illegible] compare their [illegible] knowledge and methods with those of their employer or senior in the profession to the disparagement of the latter. They forget that [illegible] theoretical knowledge has probably got rusty through giving attention to other but equally important work for many years. Even if their seniors have never been possessed of such knowledge they are nevertheless entitled to the highest respect in virtue of other knowledge they possess of which the conceited youngster straight from college knows nothing.

The college trained youth seems to forget, too, that the nomenclature of science to-day is very different from that in vogue a generation ago when their seniors were trained, hence many of the older engineers may have a very intimate knowledge of the theoretical side of engineering and yet know but little of the scientific technical terms used at the present day.

(2) The technical knowledge possessed by the raw student may not be in such a form as to be of much or [illegible] to him in actual engineering work. One occasionally meets highly mathematical men, who lack all sense of proportion as regards the accuracy required [illegible] purposes. They prefer a long but apparently exact, mathematical treatment to a short cut which is sufficiently accurate for all practical purposes. Such men give one the impression that they would rather have a tooth drawn than make use of a convenient approximation.

HOW NOT TO ORDER A CHAIN.

[illegible] will perhaps best illustrate [illegible] The head of a firm of engineers gave instructions one morning to a newly appointed draughtsman to order at once a length of [illegible] On the following day the [illegible] after the chain had been ordered. "No," replied the draughtsman; "I have not quite finished my calculations for arriving at the size of link required." On examining the draughtsman's notes his chief found that he had been diving deeply into the intricacies of an extension of Winkler's hypothesis, covering many sheets of foolscap. "What's all this rubbish?" asks the enraged chief. "Don't you know the simple rule that the safe load in tons for a chain is equal to the square of the number of eighths of an inch in the link divided by ten? Order a ⅞-in. chain at once." This highly mathematical draughtsman scorned a rule of thumb method of this kind, but nevertheless it gave the desired result in less than a thousandth part of the time required for the complete mathematical treatment, which, although a most elegant piece of work, was quite out of place in a commercial engineering drawing office.

IMPORTANCE OF GROUNDWORK.

Teachers who have no practical knowledge of engineering are every often responsible for this state of affairs; they confine their lectures to the higher branches of the subject which interest themselves far more than their students. In the author's opinion nearly all teachers attempt work of too high a standard before the students have thoroughly grasped the earlier stages of the subject. By all means let the higher work be done, but not until the groundwork is thoroughly mastered.

(3) They lack business capacity and ignore questions of cost. They moreover have no knowledge of how to control and direct large bodies of workmen, and are not able to inspire those under their charge with confidence in their powers and respect for their authority, all of which defects are due to the fact that they have only been trained as hothouse plants in a college instead of getting the dual college and works training which is absolutely essential both for those who have to carry out engineering work, and also for those who have to teach the principles that underlie it.

DEFECTS IN THE PRESENT SYSTEM OF TRAINING OF ENGINEERS.

One serious defect of the present system of training engineers is the tendency for college trained men to cut short their practical training, which tendency is largely due to the baneful influence of unpractical teachers. One British university actually advertises in the engineering journals that "complete theoretical and practical training is given in the university." Another professor of engineering states "that one complete year in the workshop or in the office should be all that is required in the case of a student who has gone successfully through his college course." The author is old-fashioned enough to believe that at least four years should be spent in the shops in addition to the time spent in the drawing office.

Opponents of technical education often accuse colleges of inculcating unbusiness-like habits in students, and complain that the discipline as to punctuality of attendance at classes is not sufficiently rigid. That this is a just complaint in some instances must be admitted, but at the same time there are many institutions which do keep a strict watch on attendance, and necessary steps are taken, when occasion requires, to prevent slackness. [illegible] treated as schoolboys.

Another common complaint [illegible] lecturing on constructional and other problems; that the importance of the theoretical efficiency of plant is much over-rated, and its liability to wear and breakdown is ignored; and that no instruction is given on the management of works and men. It [illegible] to a large extent these complaints are real, but the difficulty of dealing with them is [illegible]. It is a question whether such matters could be adequately treated by means of lectures or otherwise in a place not devoted to business purposes.

[illegible]

[illegible] Manchester Association of Engineers.

COAL PRODUCTION AND CONSUMPTION.

THE following statement from a parliamentary return just issued shows the production of coal in the five principal coal producing countries of the world for the years 1902, 1903 and 1904:—

	1902. Tons.	1903. Tons.	1904. Tons.
United Kingdom*	[illegible]	[illegible]	[illegible]
Germany†	[illegible]	[illegible]	[illegible] ‡
France†	29,365,000	34,218,000	[illegible] ‡
Belgium†	22,877,000	23,797,000	23,507,000‡
United States*	269,277,000	319,068,000	314,563,000

* Tons of 2240 lb. † Metric tons of 2204 lb.
‡ Provisional figures.

The production of coal in 1904 in the United Kingdom and Germany was greater than in any previous year, but in France, Belgium, and the United States it did not reach the high figures of 1903.

As compared with its population, the production of coal in the United Kingdom still surpasses that in the United States, amounting to nearly 5½ tons per head, while in the United States it is still under four tons per head.

The following statement shows the average value per ton of the coal produced taken at the collieries in the five above mentioned countries in the year 1904.

United Kingdom. Per Ton. s. d.	Germany. Per Ton. s. d.	France. Per Ton. s. d.	Belgium. Per Ton. s. d.	United States. Per Ton. s. d.
7 8	8 7½	[illegible]	[illegible]	[illegible]

These prices represent a fall of about 7d. per ton in the United Kingdom, of 3d. per ton in Germany, and 5d. per ton in France, but a rise of 2d. per ton in Belgium and of 11d. per ton in the United States.

The provisional figures available for 1904 indicate a further fall of [illegible] per ton in the United Kingdom and [illegible] per ton in Germany, whilst in the United States there has also been a fall of about 8d. per ton.

IMPORTS AND EXPORTS.

Figures for the United Kingdom, Germany, and the United States (provisional) for 1904 are as follows:—

	Imports. Tons.	Exports. Tons.	Excess of Exports. Tons.
United Kingdom	[illegible]	[illegible]	65,810,000
Germany	[illegible]	[illegible]	[illegible]
United States	[illegible]	[illegible]	[illegible]

The exports of all three countries in 1904, both [illegible], were the greatest recorded.

CONSUMPTION.

The consumption of coal in some of the chief consuming countries is stated as follows:—

	1902. Tons.	1903. Tons.	1904. Tons.
United States	[illegible]	[illegible]	[illegible],610,000*
United Kingdom	[illegible]	[illegible]	[illegible]
Germany	[illegible]	[illegible]	107,160,000*
France	[illegible]	[illegible]	[illegible]
Russia	19,732,000	21,023,070	22,953,000*
Belgium	[illegible]	[illegible]	21,106,000*
Austria-Hungary	[illegible]	[illegible]	Not available

* Provisional figures.

A return showing the quantity of coal consumed for locomotive purposes by the railway companies in the United Kingdom has again been obtained. The amount of coal thus consumed was 11,445,364 tons in 1904, as against 11,399,413 tons in 1903 and 11,336,522 tons in 1902.

THE TECHNICAL LIBRARY.

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Hobbs, W. R. P., Naval Torpedo School, Portsmouth. The Arithmetic of Electrical Measurements: With examples. 1s. net Whittaker.

(*To be continued.*)

MEASUREMENT OF HIGH FREQUENCY CURRENTS.

At the Society of Arts on Monday last Professor J. A. Fleming, F.R.S., delivered the first of what promises to be an interesting series of Cantor lectures, on the Measurement of High Frequency Currents and Electric Waves. He said that going back as far as the researches of Cavendish, it was interesting to note that his determinations being measurements with the same units were quite comparable with those being made to-day. To the man immersed in large undertakings, these small measurements might, said Professor Fleming, appear things of little importance, but as he would show, in the case of high frequency currents small inductances and capacity were of very real significance in relation to practical work. It was very important to study spark resistance. A method of spark counting which he had devised, had proved of great service and had thrown fresh light on certain investigations. Spark resistance was a very complex thing, depending upon many factors, of which the chief were the capacity of the jar, the inductance of the circuit, the length of the spark, and the shape of the spark terminals. Spark resistance had been measured in another manner by Professor Slaby, at Charlottenburg, and his experiments showed that with increase of spark length, and with increase of capacity, there was a rise of resistance. He himself had found that the material of which the spark balls were composed had a marked effect on spark resistance, iron giving a higher resistance than zinc or brass. It was also notable how great was the effect of length of spark upon resistance, as had also been demonstrated by Slaby. There were, however, many anomalies, and the work of various investigators did not show agreement; but the results were not necessarily contradictory, being rather due to the different kinds of spark employed. This referred particularly to the experiments of Rempp. The lecture was illustrated [illegible] and experiments.

The Argentine Government has passed a measure providing for a system of underground railways in Buenos Aires. It is reported in press despatches that [illegible] capital is interested in the project.

At the forthcoming winter meeting of the British Association of Waterworks Engineers, to be held on December 15th and 16th, Mr. Baldwin Latham, M.Inst.C.E., will read a paper dealing with a case of lead poisoning which recently occurred in the south of England.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

Glasgow.—Supply of [illegible] 1,000-k.w. motor generators and [illegible] high and low-tension sub-station switchgear, for the Glasgow Corporation. Mr. W. W. Lackie, engineer, 75, Waterloo Street, Glasgow ... Dec. 4

East Ham.—Provision and fitting complete of additional pumping plant at the Council's outfall works, Bonny Downs, East Ham, for the East Ham Corporation. Mr. A. H. Campbell, M.Inst.C.E., Borough Engineer's Office, East Ham ... Dec. 4

London, N.W.—Supply of the following, for the Willesden District Council,—viz., 73 sluice gates, to be constructed in accordance with the drawings to be seen at the office of the engineer, and delivered to the Sewage Farm, Dog-lane, Neasden, N.W. Mr. O. Claude Robson, engineer, Public Offices, Dyne-road, Kilburn, N.W. ... Dec. 5

Southgate (Middlesex).—Work and materials required in the construction of a new bridge over the New River in the district of Southgate, for the Light Railways and Tramways Committee of the County Council. The span of the new permanent structure will be about 24 ft., with a width of about 60 ft. between the parapets, and will be constructed in brick, stone, granite, and steel, preparatory to the laying of a new light railway. Mr. H. T. Wakelam, M.Inst.C.E., county engineer, Middlesex Guildhall, Westminster, S.W. ... ... Dec. 7

London, E.C.—Deepening the navigation channel of the River Thames between Mucking Light and Gravesend and in Sea Reach, for the Conservators of the River Thames. Mr. Robert Philipson, secretary, Thames Conservancy Office, Victoria Embankment, E.C. ... ... Dec. 9

Ramsgate.—Supply, delivery, and erection of [illegible] vertical water-tube condensers and a Livesey washer, for the Gas and Water Committee. Mr. T. N. Ritson, A.M.Inst.C.E., engineer and manager, Gas and Water Offices, [illegible], Ramsgate ... Dec. [illegible]

Basingstoke.—Supply, delivery, and erection of suction gas plant, gas engines, and pumping machinery (all in duplicate) in connection with the new waterworks for the Corporation. Mr. F. Reginald Phipps, waterworks engineer, Town Hall, Basingstoke ... Dec. 11

Elham (Folkestone).—One or more superheaters for the Elham Union; also a Lancashire boiler. Mr. R. Lonergan, clerk, 11, Cheriton Place, Folkestone ... Dec. 27

Last Day.

Dundalk.—Building of a reservoir, catchments, tanks, etc., and the laying of pipes and other works near Carlingford, for the purpose of providing the village with an improved water supply for the Dundalk Rural District Council. Mr. P. R. Finnigan, clerk, Council Offices. ... ... Dec. [illegible]

Newcastle-upon-Tyne.—For the construction of a Hennebique patent ferro-concrete culvert in the valley of the Ouseburn, and other appurtenant works thereto, for conveying the waters of the burn, for the Corporation. City Engineer's Office, Town Hall, Newcastle-upon-Tyne Dec. [illegible]

COMING CONTRACTS.

Baildon.—A Local Government Board inquiry has been held relative to an application of the Urban District Council for sanction to borrow a further sum of £3,000 in respect of works of sewerage and sewage disposal for Baildon Green.

Chorley.—The Rural District Council have applied for sanction to borrow £13,900 for the provision of a water supply for the western portion of their district. An inquiry has been held.

Hindley.—An inquiry has been held into an application by the Urban District Council for a loan of £20,000 for the purposes of an amended scheme of sewerage and sewage disposal.

Teignmouth.—Mr. H. Percy Boulnois has held an inquiry into an application of the Urban District Council for sanction to borrow a sum of £21,830 for the purposes of water supply. The scheme includes the laying of about 11 miles of 9-in. mains and three miles of 4-in., building a meter-house, and crossing the tidal river Teign, which is about 450 yds. wide.

Oxford.—At a special meeting of the Town Council on November 15th, it was decided to promote a Bill to empower the Council to work and adapt the existing tramways to electric traction, and to construct additional lines.

Burton.—The Town Council have arranged with the South Staffordshire Waterworks Company for an improved water supply to Winshill. The company will erect and [illegible] a water-tower 90 ft. high at a cost of about £6,500. The Corporation will contribute £1,000, and have applied for a loan.

Bolton.—The Corporation is about to take steps towards commencing the construction of new water works at a cost which will cost over £100,000. The Dove Spinning Company have acquired land at Rumworth, on which they propose erecting a second gigantic mill.

CONTRACTS CLOSED.

London.—The Brush Engineering Company have received the following orders: A. and P. Steven, Glasgow—one car for incline railway; Great Yarmouth Corporation—two double deck cars, complete with trucks and Brush motor equipments; Portsdown and Horndean Light Railway—75 k.w. engine direct coupled to traction dynamo; Cheshire Lines Committee—six more bogie carriages; Bournemouth Corporation—five double-deck cars, each mounted on two Brill trucks with Westinghouse motor equipments, one store van and breakdown car; J. H. Tozer and Son—one first-class main line coach; Cordoba Railway—two 14 in. locomotives; Taff Vale Railway (per Manning and Wardle)—three motor coach bodies: Portsdown and Horndean Light Railway (per Dissel Engine Co.)—100 k.w. slow speed traction dynamo.

London.—Messrs. Lassen and Hjort inform us that their list of recent orders for water softening plant includes Joseph Rank, Ltd., Royal Arsenal, Bell's Asbestos Company, Ltd., Siemens Bro.'s and Co., Ltd., Italian Admiralty, James Booth and Co., Ltd., J. B. Lawes and Co., Ltd., Ruston Proctor and Co., Ltd., Antofagasta (Chile) and Bolivia Railway Company, Ltd., Mark Mayhew, Ltd., and Great Southern of Spain Railway Company, Ltd.

Newcastle.—Messrs. Henry Watson and Sons, engineers, of Walker Gate, Newcastle, have contracted to supply twin air and main circulating pumps for the four cargo steamers now building for the Peninsular and Oriental Company at Messrs. Caird's, Glasgow.

Manchester.—Messrs. R. Neill and Sons, Manchester and Newcastle, are stated to have secured the contract for the widening of the London and North-Western Railway at London Road, Manchester.

Sheffield.—Messrs. Vickers, Sons and Maxim have decided to put down a 1,000-k.w. turbine plant in their works at Sheffield, and have placed the order for the turbine, complete with condenser, etc., in the hands of Messrs. Willans and Robinson, Ltd., Rugby.

London.—The Diesel Engine Company report the receipt of orders as follows: 500 b.h.p. engine for driving the extension of the works of Messrs. Craven and Speeding Brothers: one of 225 b.h.p. for Binny and Co., Madras, one of 400 and another of 160 b.h.p. for Bradbury, Brady and Co., Bombay.

Belfast.—The Belfast Corporation has placed an order for drilling machines with Messrs. Pollock and McNab, of Bredbury, near Manchester.

London.—The tender of the Brush Electrical Engineering Company, amounting to £14,280, has been accepted by the London County Council for the supply of thirty-four single-deck steel tramcar bodies; that of the British Westinghouse Company, amounting to £13,481, for thirty-four tramcar trucks and electrical equipments, has also been accepted.

London.—The Mansfield Light Railway Company have placed a contract for six tramcars and electrical equipments with the British Westinghouse Company, Ltd.

London.—The South Metropolitan Electric Light and Power Company (late Blackheath and Greenwich Company) are extending their works at Greenwich with steam turbines, and have just placed their contracts for the installation of a Willans-Dick, Kerr turbine set. The contract for the turbine and condensing plant has been placed with Messrs. Willans and Robinson, Ltd., Rugby.

Johannesburg.—The Town Council has accepted the tender of Mr. C. Jowett, of Johannesburg, at £12,916, for the main section of tramway track construction.

APPOINTMENTS VACANT.

Radcliffe.—Radcliffe Council require an electrical engineer for their electricity undertaking. Salary £150 per annum ... Dec. 2

Cape Town.—Applications are invited for the newly-vacated professorship of electrotechnics at the South African College, Cape Town. Commencing salary £600 per annum. Agent-General for Cape Colony, 100, Victoria Street, London, S.W. ... ... Dec. 15

Trowbridge.—The Urban District Council require an experienced working mechanical engineer to take charge of sewage pumping station. Mr. H. J. Nicholson, Farley Town Hall, Trowbridge ... ... Dec. 7

Biggleswade.—The Biggleswade Water Board and the Biggleswade Rural District Council invite applications from persons who have been trained as mechanical engineers for the appointment of superintendent of the waterworks. Mr. Chandler, Clerk of Works, Biggleswade, Bedfordshire ... ... Dec. 8

APPOINTMENTS FILLED.

Leeds.—The Council of the University have appointed Dr. W. A. Bone, F.R.S., Professor of Applied Chemistry (fuel and metallurgy). Dr. Bone has devoted considerable attention to practical problems of an industrial character in relation to fuel and metallurgy.

Nelson.—The Nelson Electricity Committee have appointed Mr. A. Henry, electrical engineer of Radcliffe, to accept the vacant position at Nelson at a commencing salary of £200.

Birmingham.—Mr. Hy. Briggs, A.R.S.M., has been appointed to the post of lecturer in coal mining and demonstrator in surveying at the University of Birmingham and special lecturer in coal mining to the Warwickshire Coal Committee.

Chiswick.—Mr. P. L. Pomeroy, A.R.C.Sc., has been appointed lecturer on engineering subjects at the Chiswick Polytechnic.

Haslingdon.—J. A. Stokes, B.Sc., A.R.C.Sc., has been appointed lecturer on chemistry at the Haslingdon Technical College.

Llanelly. — Subject to the sanction of the Local Government Board for the proposed loan of £[illegible],600 for electric lighting at Llanelly, Mr. J. C. Howell, will be appointed engineer and manager for the works at £2[illegible] per annum.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies

Stock Exchange Settling Days. —Settling days on the Stock Exchange are as follows :—
Consols — Dec. 1st, Jan. 4th. General Settlements . Dec. 14th, 29th ; Jan. 11th, 25th. Bank Rate, September 28th, 1905, 4 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices.
11,[illegible]70	5	5	Alldays & Onions Pneumatic Engineering, Ltd.	3	2[illegible]—2¼
10,000	5	3	Do. Cum. Pref. 6 per cent. ..	5	4¾—5¼
[illegible],210,000	1	1	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3¼—3½
76,970	5	2/-	Do. 4% Cum. Pref.	5	5[illegible]—5[illegible]
1,500,000	100	4	Do. 4% 1st Mort. Dbs. Rd.	100	103—105
£100,000	100	4½	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96—99
530,000	1	1/7	Babcock and Wilcox, Ltd., Ord. ..	1	3¾—4
160,000	1	7½d.	Do. ,, 6% Cum. Pref.	1	1 7/16—1 9/16
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5—5½
250,000	1	6⅞d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 1/16—1 3/16
£250,000	Stk	4½	Do. 1st Mt. 4½% Deb. Stk. Red.	100	102—104
150,000	4½	3/-	Barrow Hæmatite Steel Co., Ld., O.	4½	5—5¼
50,000	4½	3	Do. do. Cum 2nd. Pref.	4½	5—5¼
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾—5¼
£500,000	100	4½	Beardmore (Wm.) & Co., Ltd. 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	104—106
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	12½—13
£366,600	Stk	4%	Do. 4% Deb. Stock, Red.	100	100—102
200,000	1	1	Beyer, Peacock and Co., Ltd., Ord.	1	[illegible]
300,000	1	6⅞d.	Do. 5½% Cum Pref.	1	¾—[illegible]
£300,000	Stk	4½	Do. 4½% Red. Deb. Stock	100	93—96
[illegible],629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	[illegible]
1,860,900	1	3⅞d.	Do. Nos. 1,639,101-3,500,000	12/-	[illegible]
1,160,000	1	10½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1⅜—1½
590,000	1	1/2	Do. Ord., Nos. 1,160,001-1,750,000	1	1⅞—2
74,000	10	5	Do. 5% Cum. Pref.	10	11½—12
154,500	5	[illegible]	Cammell, Laird & Co., Ltd., Ord. ..	5	10½—11
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5[illegible]—5[illegible]
450,000	1	1/2	Clayton & Shuttleworth, Ltd., Ord.	1	[illegible]—1[illegible]
70,000	5	2/6	Do. 5% Cum. Pref . .	5	5½—5[illegible]
£250,000	Stk	4	Do 4% 1st Mort. Db. Stk. Red	100	100—102
[illegible]	10	30	Consett Iron Co., Ltd., Ord.	7½	36½—37½
57,031	10	10	Crossley, Bros., Ld., Ord. 40340/97370	10	15¾—16
40,339	10	5	Do. 5% Cum. Pref.	10	11½—11[illegible]
75,000	1	2/6	Delta Metal, Ltd. Shares .. .	1	2¼—2¾
1,259,594	1	[illegible]	Dorman, Long & Co., Ltd.	1	[illegible]
£400,000	Stk	4	Do. 4% 1st Mort. Perp. Deb. Stk.	100	92—96
200,000	5	3	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating ..	5	3¾—4¼
250,000	1	[illegible]d.	Dunlop (James) & Co., Ltd., Ord. ..	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	[illegible]
[illegible],721	13	13	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	10½—11½
69,754	13	10	Do. do. do.	10	8¾—9¼
2[illegible]	10	[illegible]	Elliott's Metal, Ltd	8	5—5½
5,000	10	[illegible]	Do. Cum. Pref. 5%	10	8½—9½
186,748	Stk	4	Do. Deb. 4%	100	90—94
25,000	10	[illegible]	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	11¼—12¼
£250,000	Stk	4½	Do. 4½% Mort. Deb. Stk. Red.	100	100—103
[illegible]	3	[illegible]	Fraser & Chalmers, Ltd., Ord. ..	3	3¼—4¼
21,000	3	[illegible]	Do. 7½% Cum. Pref.	3	5[illegible]—6¼
10,000	10		[illegible], Ltd., 5% Cum. Pref. [illegible]	10	7½—8
£150,000	Stk	4	Do. 4% 1st Mort. Deb. Red.	100	88½—89½
[illegible]	10	10	Greenwood & Batley, Ltd., Ord. ..	10	6½—7
9,600	10	7	Do. 7% Cum. Pref.	10	10¾—11¼
965,000	1	[illegible]	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2[illegible]—2[illegible]
[illegible]	5	2/6	Do. 5% Cum. Pref.	5	6⅛—6⅜
£1,[illegible]	Stk	4	Do. 4% Irred. Mort. Deb. Stk	100	106—108
18,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. .	5	2¾—3¼
250,000	1	1	Hadfield's Steel F'dry Co., Ld., Ord.	1	3¾—4
20,000	10	4½	Do. 4½% Cum. Pref.	10	10¾—11
30,000	5	3	Hall (J. & E.), Ltd. 6% Cum. Pref. ..	5	5—5½
108,505	1	1/-	[illegible] United Steel Co., Ltd. ..	1	⅞—1
47,500	10	7½	Hawthorn, Leslie & Co., Ltd. Ord.	10	98—100
28,001	[illegible]	7	Head, Wrightson & Co., Ltd.	5	5½—6
85,030	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	[illegible]
[illegible]	[illegible]	[illegible]	Do. 6% Cum. Pref.	5	5—6¼
£100,[illegible]	[illegible]	[illegible]	[illegible] & Sons, Ld., Ord. [illegible] Cum. Pref.	100	101—103

ENGINEERING, IRON, AND STEEL COMPANIES.—*Cont'd.*

Present Amount Subscribed	Shares	Last Dividend.	Name	Paid up.	Closing Prices.
750,000	1	7½%	Howard & Bullough, Ltd., Ord. ..	1	1[illegible]—1[illegible]
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) .	10	12½—13
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98—101
37,500	10	20	Kynoch, Ltd.	10	18¼—18[illegible]
49,537	10	5%	Do. Cum. Pref. 5% .. .	10	10½—11
300,000	1	4½d.	Lambert Bros., Ltd., Ord.	1	[illegible]
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4¼—4[illegible]
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref. ..	3	4—4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1[illegible]—1[illegible]
£300,000	Stk	4½	Do 4½% 1st Mt Deb. Stk., Red.	100	109—111
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11¼—11¾
210,000	1	8d.	Measures Bros., Ltd., Ord.	1	[illegible]—1[illegible]
75,000	1	6½d.	Do. 5½% Cum. Pref. .. .	1	[illegible]—1 1/16
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	98—101
21,943	5	2/6	Muntz Metal, Ltd.	5	[illegible]
14,248	5	5%	Do. Pref. 5%	5	4[illegible]—5¼
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	78—81
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12[illegible]—12[illegible]
80,000	5		North-Eastern Steel Co., Ltd.,		
£250,000	Stk	4½	4½% 1st Mrt. Db. Stk., Red.	100	89—93
122,000	5	1/6	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	4¾—5
50,000	5	3/-	Do. 6% Cum. Pref. "A"	5	6—6½
70,000	10	10/-	Pease & Partners, Ltd., Ord. .	10	15¼—13¾
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock .	100	99—102
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P.	5	4[illegible]—5⅛
65,000	1		Pooley (Henry) & Son., Ltd., Ord ..	1	11/-—12/-
13,000	5		Do. 5½% Cum. Pref.	5	4[illegible]—4[illegible]
230,000	1		Projectile Co. (1902), Ltd., Ord. ..	1	[illegible]—½
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	2[illegible]—2[illegible]
78,062	5	2/-	Do. New .. .	5	1[illegible]—[illegible]
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	102—104
350,000	1	1/2	Richardsons, Westgarth & Co., Ltd., Ord. 350,001—700,000 ..	1	[illegible]*
£350,000	1	7½	Do. 6% Cum. Pref.	1	[illegible]—1[illegible]
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	98—101
35,000	10	12/-	Ruston, Proctor & Co., Ltd. ..	10	10¾—10[illegible]
275,000	1	6d.	Scott (Walter) Ltd., Ord.	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1—1 1/16
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94—97
£115,800	100	5%	Shelton Iron, Steel and Coal Co., Ld 1st Charge 5% Debs., Red ..	100	94—97
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	97—101
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	1[illegible]—1[illegible]
300,000	1	1/2	Do. 6% Cum. Pref. ..	1	[illegible]—1[illegible]
£300,000	Stk	4½	Do. 4½% Per. Deb. Stock	100	93—96
25,000	10		Stephenson (Robert) & Co., Ltd., Or.	10	2[illegible]—[illegible]
25,000	10	5/6	Do. 5½% Cum. Pref	10	4¾—5¼
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	[illegible]—[illegible]3
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. .	10	19¾—1[illegible]
55,000	10	6	Do. 6% Cum. Pref .	10	14½—15
684,732	1	6d.	Swan, Hunter & Wigham Richardson, Lim. Ord.	1	[illegible]
538,845	1	6d.	Do. 5% Cum. Pref.	1	[illegible]—1
£240,000	Stk	4½	Do. 4½% 1st Mort. Deb. Stk. Red	100	96—99
300,000	1	[illegible]	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	¾—[illegible]
£200,000	100	4	Do. 4% Irredeem. 1st Mort. Deb.	100	80—84
£148,500	1	7½d.	Thornycroft (John I.) & Co., Ltd. Or.	1	[illegible]—1
£160,000	1	7½d.	Do. do. 6% Cum. Pref.	1	[illegible]—1[illegible]
10,000	10	[illegible]	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9¼—9[illegible]
$508495200	$100	[illegible]	United States Steel Corp. Com. Stk.	$100	38[illegible]—[illegible]
$360311100	$100	[illegible]	Do. 7% Cum. Pref. Stock	$100	108—108[illegible]
$162268000	$1000		Do. 10-60 yr. 5% Skg. Fd. G. Bd.	$1000	100—101
3,850,000	1	1	Vickers, Sons & Maxim, Ltd. Ord. ..	1	2[illegible]—2[illegible]
750,000	1	[illegible]	Do. 5% Non-Cum. Pref. .	1	1[illegible]—1[illegible]
£750,000	Stk		Do. 5% Non-Cum. Pref. Stock.	100	120—124
£1,250,000	Stk		Do. 4% 1st. Mort. Deb. Stk. Red.	100	103—105*
£1,000,000	100	4½	Do. 4½% 2nd Mort. Debs., Red.	100	105½—107[illegible]
225,000	1	[illegible]	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	1—1[illegible]
500,0[illegible]	1	[illegible]	Do. 6% Cum. Pref. Ord. ..	1	1—1[illegible]
£300,0[illegible]	Stk	4	Do. 4% Perpetual Deb. Stock	100	9[illegible]—95
7,6[illegible]	5	[illegible]	Weldless Steel Tube, Ltd., Cum. [illegible]	5	4½—4¾
[illegible]300	Stk	4½	Do. Mort. Deb. 4½%	100	92—98
66,666	5		Willans & Robinson, Ord.	5	1½—2
66,666	5		Do. 6% Cum. Pref. . .	5	2½—3½
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	85—90
£150,000	Stk	[illegible]	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	10	77—79

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

[illegible]	Shares	Last Dividend	Name	Paid up	Closing Prices
70,[illegible]	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	[illegible]
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf	1	[illegible]
120,000	1	1 2½	Bell's Asbestos Co., Ltd. ..	1	1½–1⅝
[illegible]	5	9d	British Aluminium Co., 7% Cum Pref.	[illegible]	5[illegible]
£[illegible]	Stk	5%	Do. 5% 1st Mort. Deb. Stk. Rd.	100	9[illegible]–10[illegible]
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	[illegible]–7¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¾–6¼
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	103–10[illegible]
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	98–100
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. ..	5	2–2⅜
£616,358	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	8[illegible]–89
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	¼–[illegible]
150,000	2	2 4½	Do. 6% Pref.	2	1⅞–2
£1[illegible]5,000	Stk	4½%	Do. 4½% Perp 1st Deb. Stk..	100	93–97
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	78–81
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	11–12
40,000	5	2/6	Do. 5% Cum. Pref.	5	5⅝–[illegible]
£200,000	Stk	4	Do. 4½% 1st Mort. Deb Stk. Red.	100	10[illegible]–111
85,000	3	1/6	Crompton & Co., Ltd...	3	1[illegible]–2⅛
£100,000		5%	Do. 5% 1st Mort. Reg. Debs.	100	94–99%
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8½–[illegible]
61,000	5	3/-	Do. 6% Cum. Pref.	5	5[illegible]–6[illegible]
£300 000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	106–108
2[illegible],334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛–1⅜
£2[illegible],334	Stk	4	Do. 1st Mort. 4% Iree. Deb. Stk.	100	107–110
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1–99,261	3	1½–1⅝
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	2–2[illegible]
£344,02[illegible]	Stk	4%	Do. 4% Deb. Stock Red.	100	85–90
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	92–97
112,100	2	1 7½	Electric Construction Co., Ltd. ..	2	[illegible]
31,390	2	2 9½	Do. 7% Cumulative Pref. ..	2	1⅞–2⅛
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	92–95
10,248	10	7/6	Evered and Co., Ltd...	10	10–12
[illegible]	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½–10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	96–100
35 000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12¾–13¼
[illegible]	5	2/3	Do. 4½ Cum. Pref. ..	5	5½–5[illegible]
£50 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	109–111
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	16–17
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99–102
7,500	10		Parker, Thos. Ltd.	10	6½–7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	17/3–17/[illegible]
37,350	12	12/	Telegraph Construction and Maintenance Co., Ltd.	12	32–34
[illegible]	100	4%	Do. 4% Deb. Bonds	100	10[illegible]–101

III.—ELECTRIC TRACTION.

[illegible] Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	[illegible]
260,007	5	2/6	Do. 5% Cum Pf.	5	[illegible]
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	142–145
20,000	10	12/-	Barcelona Trams Co., Ltd., Ord. ..	10	13¼–14¼
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9¾–10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	98–101
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	97–102
75,606	1		Bath Elec. Trams. Ld., Pf. Or.	1	[illegible]
59,394	1	11·1d	Do. 5% Cum. Pf. ..	1	[illegible]–1¼
75,000	5	-	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1–1¼
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	4–4½
£425 000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	95–[illegible]
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	124–127
		5%	Pref. Ord. Stock	100	113–116
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9–10
1[illegible]6,437	10	6/-	Do. 6% Cum. Pref.	10	11–11½
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	121–123
£[illegible]	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	98–10[illegible]
100,000	5	2/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3½–[illegible]
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	[illegible]
47,000	5	3/-	Do. "B" do.	5	[illegible]
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	9[illegible]–10[illegible]
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	101–10[illegible]

Stocks and Shares [illegible]

ELECTRIC TRACTION.—*Contd.*

[illegible] Subscribed.	Shares	Last Dividend	Name	Paid up.	Closing Prices
102,268	5	5/-	Calcutta Tramways Co., Ltd.	5	[illegible]
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	10[illegible]
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	[illegible]
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	1½–[illegible]
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	100–10[illegible]
£120,000	Stk	5	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101–10[illegible]
60,000	10	6/	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	18½–14¼
59,987	10	6/-	Do. 6% Pref...	10	14½–1[illegible]
£125,000	Stk	4½	Hastings & Dist. Elec. Trams. Co., Ltd., 4% Deb Stock, Red.	100	101
80,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	2¼
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	83
125,000	10	5/	London United Trams. (1901), Ltd., 5% Cum. Pref. ..	10	10–10
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	100–10[illegible]
60,007	1		London Motor Omnibus Co., Ltd., Ord. No. 1—60,007	1	2⅛
£50,000	Stk	5	Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	103–105
314,016	1	-	Metropolitan Elec. Trams, Ltd., Def.	1	
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	1–1[illegible]
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	10[illegible]–1[illegible]
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	[illegible]–1[illegible]
110,923	8	2/9	North Metropolitan Tramways Co..	8	4¼–[illegible]
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	93–[illegible]
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	104–107
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8¼–[illegible]
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	9½–10
£220 000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	101–104
£160,000	Stk		Sunderland Dist. Elec. Trams. Ltd., 5% 1st Mort. Deb. Red	100	95–[illegible]
£275,000	Stk	12/11	Yorkshire (W. Riding) Elec. Trams. Co., Ltd., 4½% 1st Deb. Stk., Red.	100	96–[illegible]

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up	Closing Prices.
7,500	10	14	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12¼–1[illegible]
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	10½–10[illegible]
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11[illegible]–1[illegible]
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	107–109
14,000	5	3/6	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼–5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	102–105
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	9¼–[illegible]
12,498	5	3/6	Do. 7% Cum. Pref. Shares..	5	9–[illegible]
60,000	5	5/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	—[illegible]
£288,782	Stk		Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	div 104–107
70,000	5	2/6	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	6–7
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5¼
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	103–105
41,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	5[illegible]
£1[illegible]0,000	Stk	4½%	Do. do. 4½% Deb Stk., Red	100	110–112
70,595	10	7/-	City of London El. Lghtg. Co., Ld., O.	10	11–1[illegible]
40,000	10	6/-	Do. 6% Cum. Pref.	10	18¼–1[illegible]
£400,000	Stk	5	Do. 5% Deb. Stk., Red ..	100	124–1[illegible]
£300,000	Stk	4½	Do. 4½% 2nd Deb. Stk., Red	100	104–1[illegible]
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	[illegible]
30,000	10	6/-	Do. 6% Cum. Pref.	10	12[illegible]
£400,000	Stk	4½	Do. 4½% Deb. Stk., Red. ..	100	112–11[illegible]
70,000	5	2/[illegible]	Edmundson's Elec. Cor. Ltd., Ord	5	[illegible]
70,000	5	3	Do. 6% Cum. Pref.	5	[illegible]
£300,000	Stk	4½	Do. 4½% 1st Mort. Db. Stk. Reg	100	108–110
£80,000	Stk	5	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	85–90
19,000	5	2/-	Folkestone Elec. Supply Co., Ld., O	5	5½
£50,000	Stk.	4½	Do. 4½% 1st Deb. Stk., Red.	100	10[illegible]
15,000	10		Havana Electricity Co., Ltd... ..	10	9[illegible]
13,000	5	5	Hove Elec. Lighting Co., Ltd., Ord.	5	[illegible]
£50,000	Stk	4½	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100–102
150,000	1		Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	1[illegible]

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	98 —101
111,000	3	1/9	London Elec. Supply Corp., Ld., Ord.	3	1¾ - 2½
60,000	5	3/-	Do. 6% Pref.	5	4¼ — 5¼
£371,895	Stk	4%	Do. 4% 1st Mort.Db.Stk., Red.	100	99 -102
100,000	10	5%	Metropolitan Elec. Sup. Co., Ld., Or.	10	10 —10½
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5½— 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort.Db.Sk., Red.	100	109 —113
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	97— 99
£250,000		4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	101—103%
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 —100
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6¼ — 6¾
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	100 —102
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —103
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13 —14
20,000	5	3/6	Do. 7% Pref.	5	8 — 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 — 100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2 — 2½
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	76 — 80
65,000	5	4/-	South London Elec. Sup. Co., Ltd. O.	5	3¼ — 3¾
100,000	1		South Metropolitan Elec. Light & Power Co., Ltd. Ord.	1	3/16 — 5/16
50,000	1	8½d.	Do. 7% Cum. Pref.	1	1 3/16 — 1 5/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	105 —108
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	4½ — 4¾
30,000	5	2/6	Do. 5% Cum Pref.	5	5 — 5¼
£200,000	Stk	4½%	Do. 4½% 1st Mort.Deb.Stk.Red	100	104 —106
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12 —12½
28,151	5	2/6	Do. 5% Cum. Pref.	5	6 — 6½

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 — 102
25,000	10		Amazon Telegraph Co., Ld... ..	10	3½— 4¼
£763,580	Stk	14/-	Anglo-American Tel. Co., Ltd., Ord.	100	62 — 64
£3,118,210	Stk	28/-	Do. 6% Preferred Ordinary	100	109½ — 110½
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	17⅝ — 17⅞
44,000	5	5/-	Chili Telephone Co., Ltd.	5	7½ — 7¾
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	— —
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	96 — 98
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾ — 9¼
6,000	10	10/-	Do. 10% Preference .. .	10	17 —18
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3¾ — 3⅞
		5/-	10% Cum. Preference	5	9¼ — 9¾
£30,000	50	4½%	Do. 4½% Debs.	50	100-103%
60,710	20	4/-	Direct U.S. Cable Co., Ltd... ..	20	13¼ — 13¾
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	100½ — 102½
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	99½ — 101½
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100—102%
300 000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	14½—15
£602 400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 — 108
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	144 — 147
£2,000,000	Stk	17/6	Do. 3½% Pref. . .	100	89½ — 91½
£1,836,814	Stk	4%	Do. 4% Mort. Deb. .. .	100	106 —108
150,000	10	5%	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	35 — 36
£58 700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100½ — 102½
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	57 —59
72,680	1	9d.	Monte Video Telephone Co., Ltd., O.	1	¼ — ½
£1,983,338	Stk	6%	National Telephone Co., Ltd., Pref.	100	111 — 113
£1,966,667	Stk	5%	Do. Deferred	100	108 —110
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5⅜ — 5⅝
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	97½ — 99
£680,93	Stk	4%	Do. 4% do. do. ..	100	104 —106
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1¼ — 1⅜
50,000	1	7½d.	Do. 6% Cum. Pref. .	1	1 1/16 — 1 3/16
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	100—103
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7½— 8
78,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7 — 7½
40,000	5	2/6	Do. 5% Cum. Pref. . ..	5	5¼ — 5⅝
£179,947	Stk		Do. 5% Deb. Stock, Red. ..	100	110 —112
15,009	10	1/-	W. African Telegraph Co., Ltd. ..	10	10 — 10½
£30,000	2½		West Coast of America, Ltd. ..	2½	¼ — ½
£40,000	100	4%	Do. 4% Deb., Guar. by West. Tel.	100	100 — 102

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices.
88,321	10	6d	W. India & Panama Teleg. Co., Ld., Or.	10	½ — ¾
34,563	10	6/-	Do. 6% Cum. 1st. Pref. .	10	8½ — 9
4,669	10	6/-	Do. 6% Cum. 2nd Pref. .	10	6½ — 7½
£80,000	100	5%	Do. 5% Deb.	100	101 — 104
207,930	10	8/-	Western Telegraph Co., Ltd. ..	10	14 — 14½
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	102 —104
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	103 —105

VI.—SHIPPING COMPANIES.

Present Amount Subscribed	Shares	Last Dividend.	Name	Paid up.	Closing Prices
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	9¼ — 9¾
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 -101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk. Red	100	98 -100
10,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum Pref	10	6¼— 6¾
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk	100	91 — 93
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. .	100	99 —101
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13 — 13½
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5¼ — 6¼
£464,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	102—104
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1½ — 1¾
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	5 — 5½
36,758	8	4/9½	Do. Non-Cum. 6% Pref. .. .	8	8½— 9
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	98 —100
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2 — 2½
40,000	5	2/9	Do. 5½% Cum. Pref. ..	5	2¾— 3¼
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red	100	88 — 91
141,500	10	5/-	Leyland (Fredk.), & Co. (1900), Ltd., 5% Cum. Pref. .	10	5¾ — 6¼
20,349	10	5%	Orient Stm. Nav. Co. Ltd., Pref Nos. 1-20,349 ..	10	7 - 7½
£103,160	Stk	4%	Do. 4% Deb. Stk., Red.	100	89— 92
£1,160,000	Stk	5%	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	127—130
£1,160,000	Stk	19%	Do. do Deferred .	100	244 —247
15,000	100	30/-	Royal Mail Steam Packet Co. Ord	60	45 — 47
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾ — 5¼
39,075	5	2/6	Do. "B" Ord.	5	3¾ — 4¼
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¾ - 9¼
21,000	10	4/6	Do. 4½% Cum. Pref. .	10	10¾ — 11¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	100 —103

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed	Shares	Last Dividend.	Name	Paid up	Closing Prices
60,000	1	9⅜d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞ —1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	124 —129
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	26 — 28
10,000	10	6/-	Do. do. 6% Cum. Pf	10	14 — 15
183,588	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250 .. .	15/-	½ — ¾
66,462	1	8·4d	Do. do Nos. 1-66,462	1	⅝ — ⅞
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1⅛ -1¼
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1¼ -1½

RAILWAY CARRIAGE & WAGON COMPANIES.

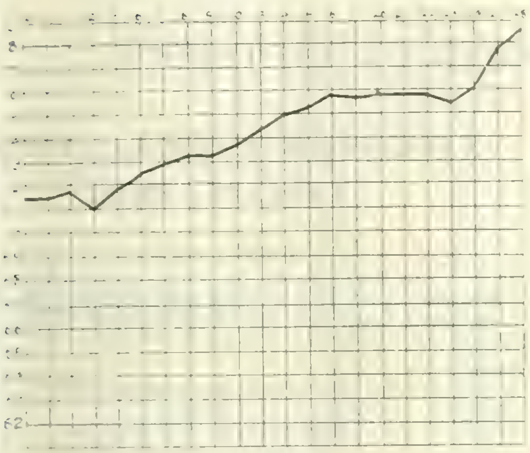
Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up.	Closing Prices.
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	25 — 26
8,739	10	3/-	Do. Second Issue 1-8,739....	4	9¼ — 9¾
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 —14½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	10⅜— 10⅝
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4½ - 4¾
14,567	10	1/8	Lancashire Wagon, Ord.	2	2 — 2¼
4,150	10	5%	Do. do.	10	10⅜ — 10⅝
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	2 1/16 — 2 3/16
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	1⅛— 1¼
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/6 — 29/6
20,000	20	20/-	Midland Rail.-Car & Wagon, Ld., 1-20,000	10	20 — 21

Stock and Shares marked * are quoted ex dividend

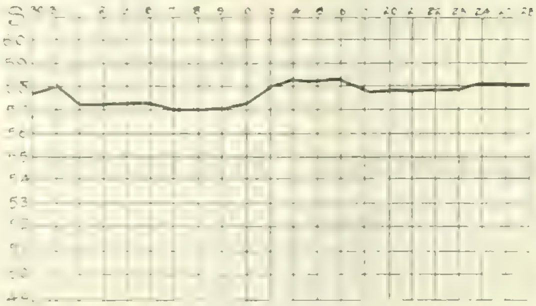
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM OCTOBER 30TH TO NOVEMBER 28TH 1905.

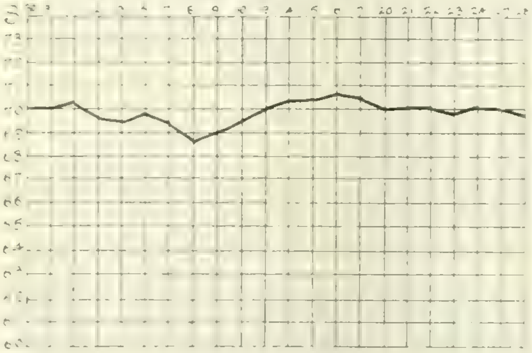
COPPER.



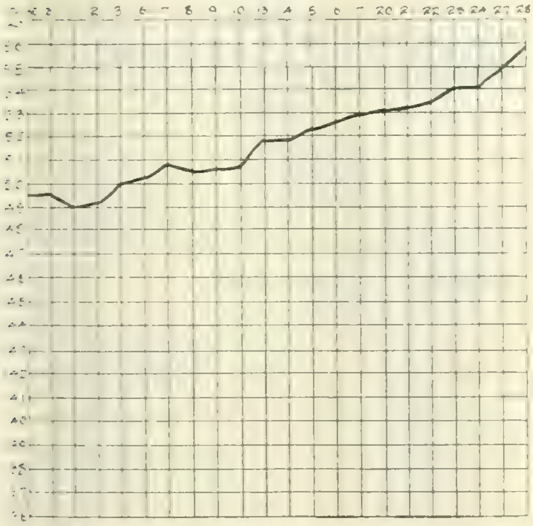
PIG IRON: SCOTCH.



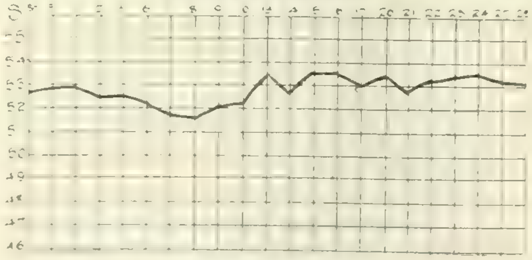
HEMATITE.



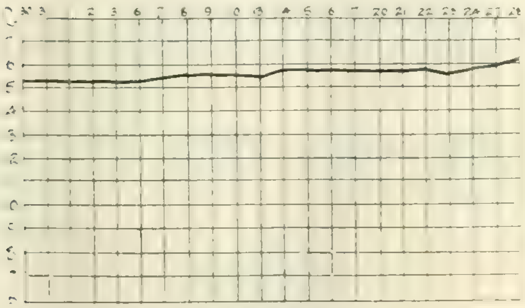
TIN.



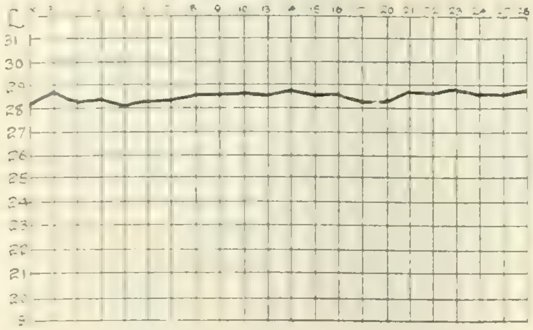
CLEVELAND.



ENGLISH LEAD.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, November 29th, 1905.

THE attempts which have been made by the big interests to prevent too rapid an advance in the price of Copper, have practically failed. A month ago Standard Copper stood at £71; while the price at the time of writing is £78 for cash metal. The reason for this high level of quotations is the perfectly natural one of large consumption of the metal, which has led to a practical total exhaustion of stocks. It is well known that the Amalgamated Copper Company has sold its entire production of the metal up to March next, and other leading producers are understood to be equally well sold.

The Tin Market has been strong and active, with a growing demand from consumers the leading feature. America has been a steady buyer, and Eastern advices have been strong. In spite of the imminence of a Banca sale and one or two spasmodic attempts to check the upward movement, the trend of prices has been towards a higher level, and the market closed strong to-day at the highest points touched—£156 10s. cash, and £156 three months.

All offerings of Lead have been absorbed, the latest business reported being at £16 2s. 6d., with English lead at £16 7s. 6d.

Spelter remains steady, with G.O.B. December quoted £28 15s. American advices have been strong, and a stimulus has been given to the market by the operations of Continental dealers, who are stated to have absorbed large quantities of Silician Spelter from producers for delivery during the first three months of next year.

Activity has characterised the Pig-iron Market during the past week, and the prevalent feeling is one of optimism. The general trading position has undergone no particular change during the week, but the outlook remains good. The predicted shipments of Middlesbrough iron to Germany and the United States have not yet materialised, and many are of opinion that at present parity shipments are rather improbable. The stock in Connall's Middlesbrough store continues to increase. The latest tendency in the market is towards realisation, Cleveland being quoted 52s. 8d., Scotch 58s., and Hematite 69s. 9d. Standard is quoted at 52s.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal :—

	Steel :	£	s.	d
DALZELL	Siemens' Steel Plates, Marine Boiler Quality ..	8	2	6
♛♛	,, ,, ,, Land ,, ,, ...	8	2	6
STEEL	,, Steel Bars Boiler Quality	8	5	0
DALZELL	Siemens' Steel Plates Ship Quality Plates......	7	2	6
♛	,, ,, Bars ,, ,, ...	7	15	0
STEEL	,, ,, Angles.........	6	15	0

Manufactured Iron :

Bars—Dalzell	7	2	6
,, Best	7	12	6
,, ,, Horseshoe	7	12	6
,, Angle..............	7	2	6
,, Best Angle	7	12	6
,, Best Best	8	2	6
,, Extra Best	8	12	6

Usual terms and extras. Special rates for delivery in England and export The above prices subject to alteration without notice.

Malleable Common Bars :	£	s.	d.	
Dalzell, per ton	7	2	6	5 per cent
Govan	6	10	0	,,
North British	6	10	0	,,
Drumpellier	6	7	6	,,
Waverley	6	10	0	,,
Crown .	6	5	0	,,
Dundyvan	6	5	0	,,
Muirkirk	6	5	0	,,
Rochsolloch	6	5	0	,,
Phœnix	7	5	0	,,
Coatbridge	7	2	6	,,
Coats	6	5	0	,,
Angle Iron	—			,,
Steel Plates, ship				,,
,, Boiler Plates ..				,,
Rails...				,,
Railway Chairs				,,

G.M.B. at Glasgow, No. 1, 64s. ; No. 3, 61s.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quote :—

	£	s.	d.
Bars—Phœnix	7	5	0
,, Best	7	15	0
,, Best Best	8	5	0
,, Extra Best..	8	15	0
,, Best Horse Shoe	7	15	0
,, Extra B.H.S	8	15	0
,, Extra Best Cable	9	5	0
,, Rivet	7	5	0
,, Best Scrap Rivet	8	5	0

	£	s.	d.
Angles—Phœnix	7	5	0
,, Best	7	15	0
,, Extra Best	8	5	0
Gas Tube Hoops—Phœnix Best	7	15	0
Plates—Phœnix	—		
,, Best Boiler	8	10	0
,, Best Best Boiler	9	0	0
,, Extra Best Boiler	10	0	0
Boiler Tube Strips—Phœnix	9	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth Granton, Leith, or Ardrossan. 5 per cent discount cash monthly

Messrs. R. Feldtmann and Co., of Glasgow, quote (Commission extra).

Pig Iron:	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	16	0	3	6	0
Gartsherrie ,,	3	8	6	3	3	6
Summerlee ,,	3	11	0	3	6	0
Carnbroe ,,	3	5	0	3	2	0
Langloan ,,	3	10	0	3	5	0
Calder ,,	3	7	6	3	2	6
Clyde ,,	3	8	0	3	3	0
Glengarnock, f.o.b. Ardrossan	3	8	0	3	3	0
Eglinton ,, ,,	3	2	6	3	0	0
Dalmellington, ,, Ayr		—		3	0	0
Shotts ,, Leith	3	7	6	3	2	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W ♛ Bars	7	5	0
W.W. Best Bars	7	12	6
W.W. Best Best	8	0	0
W.W. Best Best Best	8	7	6
W.W Best Shoe	7	15	0
Thornaby ♛	8	15	0
Thornaby Best	9	5	0
Thornaby Best Best	10	5	0
Whitwell Special Admiralty Cable	10	15	0
Special Chain Iron	9	15	0
Tube and Nail Strip iron .... net cash	7	5	0
W.W. ♛ Angle Iron	7	7	6
W.W. Best Angle Iron	7	15	0
Tee Iron, to 8-inches United	8	5	0

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd., Dallam and Bewsey Forges, Warrington, quote as follows:—

		Iron.			Steel.		
		£	s	d.	£	s.	d.
♛	Bars	7	5	0	7	10	0
	Angles	7	15	0	8	0	0
(BNF)	Tees	8	5	0	8	10	0
♛	Hoops	7	10	0	8	0	0
W.I.W	Sheets	8	15	0	9	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.

Extras for Sizes and Cutting as per List.

Lots under 5 cwts. of a size 10s. per ton extra.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

	Singles 20 G 96in. by 86in. per ton.			Doubles 21 to 24 G 96in. by 86in. per ton.		
Black Sheets	£	s.	d.	£	s.	d.
"Vale"	10	10	0	11	0	
"Shield"	11	0	0	12	0	
"Severn"	12	0	0	13	0	
"Baldwin Wilden B"	13	0	0	14	0	0
Charcoal	17	0	0	18	0	0
Best Charcoal	19	0	0	20	0	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s	d	£	s.	d.
No 3 Lead	14	0	0	15	0	0
S.V Lead	15	10	0	16	10	0
No. 3 Terne	15	10	0	16	10	0
S.V. Terne	17	0	0	18	0	0

	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in per ton.		
Tinned Sheets:	£	s.	d.	£	s.	d.
Best Coke (Finish)	29	0	0	30	10	0
,, Charcoal (Finish)	31	0	0	32	10	0
Extra ,,	33	0	0	34	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	13	7	6	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	15	10	0	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	14	7	6	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	7	5	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	15	0	,,
Angles	7	10	0	
,, Best	8	0	0	
T's	7	15	0	,,
,, Best	8	5	0	
Best Shoe Iron	8	15	0	
,, Rivet Iron	8	15	0	
,, Best Rivet (Special)	10	0	0	
,, Cable	10	0	0	
,, Screwing	9	0	0	

	£	s.	d.	
Best Tinning	8	15	0	per ton.
,, Plating	9	0	0	,,
Best Best	10	0	0	,,
Treble Best	11	0	0	,,
Plates	8	5	0	,,
Best Plates	8	15	0	,,
,, Boiler Plates	9	5	0	,,
,, Best Boiler Plates	10	5	0	,,
Treble Best Boiler Plates	12	15	0	,,

Delivery f.o b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails steel nails, &c.

Discounts—

42½ per cent off 1 inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

37½ per cent off 3½-inch to 7-inch strong rose and 10dy. and 20dy. pound.

37½ per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 10/6 per cwt.
4 cwt. lots and upwards 10/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch to 6-inch basis—

2 tons 9/3 per cwt.
4 cwt. lots 9/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £8 per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E.C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

Coke Tin-plates.	Per Box. f.o.b. Wales. £	s.	d.
C 18¾ by 14 124s. 110 lb. "BV"	0	13	3
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	9
C 20 by 14 112s. 108 ,, "Lydbrook"	0	13	0
C 28 by 20 112s. 216 ,, "Lydbrook"	1	6	3
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	13	9

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:		£	s.	d	
Blooms	at	4	2	0	per ton.
Billets	at	4	4	0	,,
Sheet Bars	at	4	6	0	,,
Finished Steel:					
Bars	at	5	15	0	per ton.
Angles	at	5	16	0	,,
Tees	at	5	19	0	,,
Joists	at	5	0	0	,,
Fencing Standards	at	5	15	0	,,
Shoeing Bars	at	5	19	0	,,
Tyre Bars	at	5	19	0	,,
Half Round Bars	at	6	3	0	,,
Heavy Rails	at	5	10	0	,,
Light Rails	at	5	10	0	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d		£	s	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	158	10	0	to	159	0	0	per ton
English Bars, f.o.b. Dis. 1¼% & 1%	159	10	0	to	160	0	0	,,
Straits G.M.B., cash Warehouse, Net	155	17	6	to	156	0	0	,,
Straits G.M.B., 3 months, Warehouse, Net	155	10	0	to	155	12	6	,,
Australian, Mt. Bischoff, Warehouse, Net	156	5	0	to	156	10	0	,,

COPPER.

Copper:	£	s	d.		£	s	d.	
Standard G.M.B., cash Warehouse, Net	78	12	6	to	78	15	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	77	12	6	to	77	15	0	,,
English, Tough, Cake & Ingot, Warehouses, Net	81	10	0	to	82	0	0	,,
English, Best Select, Warehouse Net	82	10	0	to	83	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	90	0	0	to	91	0	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	86	0	0	to	87	0	0	,,
Electro, Warehouse, Net	82	15	0	to	83	0	0	,,
Ore, ex ship	0	13	3	to	0	14	3	per unit
Regulus, Matte and Precipitate, ex ship,	0	14	3	to	0	14	9	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%	0	0	7½	per lb
Sheathing ,, ,,	0	0	7¼	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	28	10	0	to	28	15	0	per ton.
Blende of 50 % Net	8	0	0	to	8	7	6	,,
Calamine, Net	8	9	0	to	8	10	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	16	0	0	to	16	2	6	per ton.
Spanish, ex ship, Dis. 2½%	15	17	6	to	16	0	0	,,
Lead Ore of 70 %, Net	7	10	0	to	8	0	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	52	0	0	to	53	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	12	10	0	to	15	0	0	,,
Crude, ex ship, Dis. 2½ %	25	0	0	to	30	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	5	0	per flask
Italian ,, ,, ,,	7	2	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote Free per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	6	6
Best Hard Steam (hand picked, as used by the Railway Companies)	5	6
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston, quote as follows, per ton at pit.

Kilburn Coal:	s.	d.
Best London Brights	9	3
Large Nuts (1½ to 3½)	9	0
Small Nuts (¾ to 1½)	6	0
Peas (½ to ¾)	5	0
Rough Slack	4	0
Slack	3	6
Smudge	2	0

Rutland Coal:	s.	d.
Brights (4 to 8)	7	6
Large Nuts (2 to 4)	7	0
Slack	3	6
Hand-picked Hards	7	6
Hard Cobbles	6	3

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	 d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit :—

Digby Coal:

STEAM	s.	d.
Best Hand Picked Hard	8	6
Steam Hard	7	3
Hard Nuts	6	6

Gedling Colliery.

HIGH HAZEL (or Ashless House Coal).		
London Brights, 4 to 8 in. cube	11	0
Bright Cobbles (Hand Picked)	10	6
Large Nuts, 2 to 4 in. cube	10	0
Small Nuts, 1 to 2 in. cube	6	3
Pea Nuts, ⅜ to 1 in. cube	5	0
STEAM.—TOP HARD.		
Best Hard	8	6
Hard Steam	7	6
Cobbles	6	3

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote :

		£	s.	d.	
Acids:	Oxalic	0	0	2½	per lb.
	Picric, Crystals	0	0	11	
	Tartaric [illegible] at Manchester	0	0	10[illegible]	

		£	s.	d.	
Acetate of Lime:	Brown at Manchester net	8	10	0	per ton.
	Grey ,,	11	15	0	
Alumina:	Alum, Lump, loose	5	5	0	
	,, ,, in casks	5	7	6	
	,, Ground, in bags	5	15	0	,,
	Sulphate of Alumina, 14%	4	10	0	

		£	s.	d.	
Ammonia:	Carbonate	0	0	3⅜	per lb.
	Muriate Grey f.o.b. Liverpool	24	15	0	per ton.
	Sal-ammoniac, Lump, 1sts, del^{d.} U.K.	42	0	0	
	,, ,, 2nds, ,,	40	0	0	
	Sulphate f.o.b. Liverpool	12	12	6	
Arsenic:	Best White Powdered net	15	0	0	
Bleaching Powder,	35% ,,	4	7	6	
Borax:	British Refined Crystal ,,	13	0	0	

Coal Tar Products:	£	s.	d.	
Benzole, 50 90% ,,	0	0	8½	per gal.
,, 90% ,,	0	0	9	,,
Carbolic Acid Crystals, 34 35° C. ,,	0	0	6	per lb.
,, ,, ,, 39/40° C. ,,	0	0	6¼	,,
,, ,, Liquid, 97 99% ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	1	10	,,
Creosote, ordinary good liquid ,,	0	0	1¼	,,
Naphtha, Crude, 20% at 120° C. ,,	0	0	4	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	1	0	,,
,, ,, 95% at 160° C. ,, ,,	0	1	0½	,,
,, ,, 90% at 190° C. ,, ,,	0	1	1½	,,
,, Rectified, flash point over 73° F. f.o.b. ,,	0	1	1½	,,
,, Rectified, flash point over 100° F. f.o.b. ,,	0	1	2½	,,
Naphthalene, all qualities.				
Pitch f.a.s. Manchester. ,,	1	13	0	per ton.

		£	s.	d.	
Copperas:	Green, in bulk ,,	0	12	6	
	,, barrels f.o.b. L'pool ,,	1	18	6	,,
	Cake ,,	1	1	6	,,
Copper:	Sulphate	24	10	0	,,

		£	s.	d.	
Cyanides:	98% minimum f.o.b. net	0	0	7½	per lb.

		£	s.	d.	
Lead:	Acetate (Sugar) White, English	27	10	0	per ton.
	,, ,, ,, Foreign c.i.f. U.K	24	10	0	,,
	,, ,, Grey	22	15	0	
	,, ,, Brown at Manchester	17	15	0	,,
	Nitrate	25	10	0	
	Litharge, Flake	17	5	0	,,
	,, Powder	17	15	0	,,
	Red Lead, Genuine, c.i.f London less 5%	16	15	0	,,
	White ,, ,, Dry ,, ,, ,,	18	0	0	,,

		£	s.	d.	
Naphtha (Wood):	Miscible, 60 o.p.	0	2	4	per gal.
	Solvent	0	2	7	

		£	s.	d.	
Potash:	Bichromate... delivered England...	0	0	3	per lb
	Carbonate, 90/92% ... c.i.f Hull ...	17	15	0	per ton.
	Caustic, 75/80% ,, ,, ...	19	5	0	,,
	Chlorate net	0	0	3¼	per lb.
	Montreal in Store, Liverpool	31	10	0	per ton.
	Prussiate Yellow net	0	0	4¾	per

	£	s.	d.	
Soda: Ash, Caustic, 48 , Ordinary .. net	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %........... ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 .... net	6	10	0	,,
Caustic, White, 77 .... ,,	10	12	6	,,
,, ,, 70 %.............. ,,	9	12	6	,,
,, ,, 60 %.............. ,,	8	12	6	,,
,, Cream, 60 %................ ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs...........	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	3¼	per lb.
Nitrate...ex quay Liverpool, ... ,,	11	0	0	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	$3\frac{7}{16}$	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	10	0	,,
,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers	7	10	0	,,
Zinc: Sulphate	6	15	0	,,
Shellac: Standard TN orange spot	9	0	0	per cwt.

MINERALS.

Messrs. S. W. Royse and Co., quote:—

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/– to about 30/– per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports......................	3	10	0	,,
Manganese: Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

Messrs. Henry Bath and Son, quote:—

	£	s.	d.		£	s.	d.	
Copper, Ores of, 10 to 25%	0	13	3	to	0	14	3	per unit.
Regulus, 45 to 55%	0	14	3	to	0	14	9	,,
Precipitate, 65 to 80% ...	0	14	4½	to	0	14	10½	,,
Tin Ores, 70	95	0	0	to	97	0	0	per ton
Lead Ore, 70%					8	0	0	,,
Blende, 50%					8	6	6	,,
Calamine					8	9	0	,,
Antimony, [illegible] Regulus	48	0	0	to	50	0	0	,,
,, Ore 50%......	12	10	0	to	15	0	0	,,

Messrs. Barrington and Holt, Cartagena, quote:—

Iron Ore

			s.	d.	
Ord. 50%, ...	f.o.b.	Porman	7	6	per ton.
Do.	,,	Cartagena	7	10	,,
Special low phos.	,,	Porman			
Do. do.	,,	Cartagena............	8	2	,,
Extra quality do.	,,	,, ...	8	6	,,
Special Iron Ore	,,	,, ...	nominal		,,
[illegible]			11	0	,,
[illegible]			9	6	

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	3
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	3
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	4	0
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do.	,,	11	10	0		13	0	0
St. John, Miramichi, etc., Spruce	,,	7	10	0		7	15	0
Nova Scotia Spruce..	,,	7	7	6		7	12	6
Spruce Boards	,,	6	7	6		6	12	6

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s	d		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	1	0		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak	per load	12	0	0		19	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak........	,,	0	2	0		0	3	0
Norway Spars	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0		12	10	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	11	10	0		16	0	0
Wyburg	,,	11	0	0		12	10	0
Uleaborg	,,	10	0	0		12	10	0
Gothenburg	,,	11	0	0		16	0	0

SELECTED PATENTS.

NEW PATENTS APPLIED FOR.

(November 13th–[illegible])

TURBINES.

[illegible] M[illegible] [illegible]—[illegible]

[illegible] Morgan [illegible]—Improvements in turbines.

[illegible] and H. [illegible]—Improvements in or relating to turbines.

[illegible]—Improvements in [illegible] fluid turbines.

[illegible] W. [illegible], London.—Improvements [illegible] turbines.

23,778. W. B. Johnson, Liverpool.—Improvements in turbines.

[illegible] R. [illegible] and J. F. [illegible], London.—Improvements relating to steam and [illegible] turbines.

BOILERS, ETC.

[illegible] H. [illegible], Bristol.—Improvements in flame and heat deflectors for hot-water boilers.

23,327. R. B. Smith, Lee.—Mechanism for increasing and regulating the circulation of the water in steam [illegible].

23,417. C. Bourdon, London.—Improved multitubular boilers with fixed elements.

[illegible] Hollinwood.—[illegible] alarm for steam boilers.

[illegible] H. K[illegible], Newcastle-on-Tyne.—Steam boiler with internal combustion of gas or liquid fuel.

23,613. O. Donatz, London.—Improvements in boiler flue cleaners.

[illegible] H. M[illegible], London.—Improvements [illegible] furnaces of steam boilers.

23,834. A. G. Browning London.—Improvements [illegible]

INTERNAL COMBUSTION ENGINES.

[illegible] B. J. King, London.—Improvements relating to crank movement in internal combustion or explosion engines, or in machinery where automatic or adjustable crank movement is to be desired.

23,374. P. L. Omant, London.—Improvements relating to internal combustion engines.

23,434. H. V. Binns, Leicester.—Improvements in carburetters for internal combustion engines.

[illegible] and [illegible]—Improvements in internal combustion engines.

23,556. F. H. Royce, Manchester.—Improvements in distributor for multiple cylinder internal combustion engines.

[illegible] F. H. R[illegible], Manchester.—Improvements in internal combustion engines.

[illegible] The New Arrol-Johnston [illegible], Ltd., and J. S. Napier, Glasgow.—Improvements in or connected with carburetters for internal combustion engines.

23,593. A. T. Blythe, London.—An improved valve gear for internal combustion engines.

23,597. E. E. Bentall and G. C. Bingham, London.—Improved sparking mechanism for internal combustion engines.

23,630. C. R. Stockley, London.—Improvements in internal combustion engines.

[illegible]pany, Ltd., and E. L. Rankin, London.—Improvements in or connected with internal combustion engines.

23,640. E. E. Glaskin, London.—Improvements in exhaust silencers for internal combustion engines.

23,684. H. Gibson, Birmingham.—Improvements in the mode of and means for indicating the pressure in the cylinder of internal combustion engines, steam engines, and the like.

MACHINE TOOLS AND APPLIANCES.

23,306. J. M. Ralston, London.—Improvements in and relating to nut tapping machines.

23,389. H. A. Phillips, London.—An improved tool for use in mounting and dismounting the valve-springs and valves of internal combustion engines, and other engines employing spring-actuated valves.

23,410. F. W. Howorth, London.—Improvements in machines for making wire chains.

23,435. T. S. King and W. Norris, London.—Improvements in pneumatic hammers.

23,478. D. Mitchell and Co., Ltd., and Crabtree, Keighley, Yorks.—Improvements in or appertaining to radial drilling machines.

[illegible] J. M[illegible] and A. M[illegible], Glasgow.—Improvements in and relating to metal-punching machines.

23,621. C. C. A. Hardie, London.—Improvements in pneumatic hammer tools.

23,667. C. A. Andrew, Godley, Cheshire.—Improvement in drilling, tapping, and studding machines and like machine tools.

23,694. H. B. Stocks and J. R. Webb, Manchester.—Improvements in or relating to percussive hand tools, power hammers and similar tools actuated by compressed air.

[illegible] W. J. B[illegible], Cambridge.—An improved mechanical appliance for milling in lathes.

MARINE.

[illegible]—Improvements in paddle-wheels for propelling marine vessels.

23,403. D. W. Stibbs London.—Improvements in bulkhead doors.

23,416. W. Dentith and H. Midgley, Rochdale.—Divers' and miners' portable and electrical lamp.

23,508. C. Omassi, London.—Improvements in syrens.

23,519. S. Brotherhood and C. W. Bryant, London.—Improvements relating to torpedo propulsion.

23,520. B. G. Nariochkine, London.—Improvements connected with submarines.

[illegible] Manchester.—Improvements in submarine boats.

[illegible] Manchester.—Improvements applicable in connection with the valves of steering and like engines.

23,609. T. F. J. Truss, London.—Improvements relating to motor installations for launches and other vessels.

[illegible] anchors.

23,819. W. Denton and D. Snaith, London.—[illegible]

IRON AND STEEL.

[illegible] Manchester.—Improve[illegible]

[illegible] East Grinstead.—Improvements [illegible] mills and the like machines.

[illegible] and A. [illegible], London.—New or improved means for automatically charging blast furnaces.

23,592. C. Henning, London.—Process for manufacturing foundry pig iron.

[illegible], London.—Apparatus for forging bits for drilling or boring purposes.

[illegible], Birmingham.—An improved flux or physic for the treatment of cast-iron and other metals.

[illegible], Birmingham.—Improvements in the manufacture of rolls for rolling mills.

[illegible], London.—Improvements in reversing valves for regenerative furnaces.

[illegible], London.—Improvements in and in connection with sand moulding machinery.

MINING.

[illegible] and [illegible].—A new apparatus for cleaning coals or ores.

23,319. T. E. Beaumont, London. Improvements in apparatus for use in recovering gold from disintegrated ores.

[illegible] and [illegible].—Improvements in brakes for miners' trucks.

23,408. J. Asbeck, London.—Improved process for obtaining lead and silver from their ores.

23,449. J. Swinburne, London.—Electric working of mine shafts.

23,450. J. Swinburne, London.—Treatment of poor ores.

23,669. R. Middleton, Leeds.—An improved mode of arranging a double-acting locking device in connection with dual gates for the cages of hoists and the like, and apparatus therefor.

23,713. C. Burnett, London.—Improvements in apparatus for washing and grading coal and other minerals especially applicable to fine coal.

23,784. W. Taylor, Nottingham.—Improvements in or relating to miners' safety and other lamps, and the like.

METALLURGICAL.

23,312. S. O. Cowper-Coles, London.—Improvements in connection with the electro-deposition of copper and other metals

[illegible], London.—Improvements in removing metallic cylinders from mandrels on which they are electro-deposited.

23,402. P. Girod, London.—Improvements in electric furnaces.

[illegible] and [illegible] W. [illegible], Nottingham.—Improvements in and relating to the electro-deposition of metals, alloys and the like.

[illegible], London.—Improved process for the alloying and amalgamation of metals.

[illegible], London.—Improvements [illegible]

ELECTRICAL.

[illegible].—Improvements in laying electric conductors.

23,267. B. C. Pole, London.—Momentum engine and electrical self-generation dynamo and motors.

23,318. J. Y. Johnson, London.—Improvements in connection with mercurial vapour lamps.

[illegible], London.—Improvements in electrical conduit tubing joints.

23,437. The British Thomson-Houston Company, Ltd., London.—Improvements in and relating to incandescent electric lamps. (The General Electric Company, United States.)

23,438. The British Thomson-Houston Company, Ltd., London.—Improvements in and relating to electric distribution systems. (The General Electric Company, United States.)

23,440. The British Thomson-Houston Company, Ltd., London.—Improvements in and relating to electric distribution systems. (The General Electric Company, United States.)

23,441. The British Thomson-Houston Company, Ltd., London.—Improvements in and relating to electric railways. (The General Electric Company, United States.)

23,442. The British Thomson-Houston Company, Ltd., London.—Improvements in and relating to methods of manufacturing incandescent electric lamps. (The General Electric Company, United States.)

[illegible].—Improvements relating to electrical furnaces.

[illegible] W. [illegible] and F. [illegible].—An improved method of fixing the grooved casing covers as used for the wires in electric lighting.

23,569. E. Bailey, W. Plews, and T. W. Anderson, Leeds.—Improvements in electric accumulators.

23,582. W. McGeoch and Co., Ltd., and W. L. Barber, Birmingham. Improvements in electrical switches.

[illegible] and [illegible], London. Improvements in electric motor apparatus applicable to machinery of all kinds requiring force.

23,595. G. Paul, London.—Improvements relating to electric railways and tramways on a road contact system.

23,624. The Felten and Guilleaume-Lahmeyerwerke Akt.-Ges., London.—Improvements in electric circuit breakers.

23,661. E. Arnold and J. L. La Cour, Liverpoool—Improved arrangement for the regulation of speed of compensated single-phase motors.

23,662. C. H. Robinson, Carlton House, Pontypool, Monmouthshire. An expanding terminal connections for electric cables and the like.

23,720. A. P. Zani, London.—Improvements in and relating to transformers and the like.

23,722. Deutsche Telephonwerke R. Stock and Co., G. m. b. H., London.—Improvements in and relating to systems of connections for telephone offices with separated plug-service and means for signalling whether an operator is unoccupied or engaged.

[illegible], Ltd., London.—Improvements in or relating to commutators and the like.

23,751. W. H. Scott, London.—Improvements in brush contacts for electric switches.

23,756. E. W. Hill, London.—A new or improved junction box for electric cables.

[illegible] The British Thomson-Houston Company, Ltd., London.—Improvements in and relating to apparatus for changing the frequency of alternating electric currents. (The General Electric Company, United States.)

23,839. The British Thomson-Houston Company, Ltd., London.—Improvements in dynamo [illegible] Company, United States.)

MISCELLANEOUS.

[illegible] A. [illegible] Manchester.—Improvements in [illegible] gas [illegible].

[illegible] J. [illegible] London.—Improvements in and relating to the separation of dust from gases.

23,419. G. H. A. PERLSTRÖM, London.—Improved distributing valve motion for piston machines especially for driving mechanical stokers.

23,448. G. NORTON, West Bromwich.—Improved method of actuating valves for three-throw pumps.

23,486. E. SCOTT-SNELL, London.—Improvements in connection with steam injectors and ejectors.

[illegible] R. [illegible] AND A. [illegible] [illegible]WATER, London.—Improvements in plummer blocks for journal bearings.

23,589. F. H. HOLBOROW, London.—Improvements in lubricators.

23,596. E. E. BENTALL AND G. C. BINGHAM, London.—Improvements in the construction of crankshafts.

23,628. DAVY BROS., LTD., AND T. E. HOLMES, London.—Improvements in or relating to steam hydraulic intensifier apparatus.

23,631. C. R. STOCKLEY, London.—Improvements in fluid pressure pumps.

23,642. W. H. WAKFER, London.—An improved cock or valve.

23,660. R. C. Craig, Glasgow.—Improvements in duplex pumps.

23,685. T. C. HOWLCROFT, Liverpool.—Improvements in and connected with steam cylinders and their pistons.

23,725. A. G. BROOKES, London.—Improvements in the method of and apparatus for polishing the inner surfaces of tubular bodies, rings, and the like. (Draper Company, United States.)

23,755. F. W. BROWN, York. Improvements in and relating to wheels for vehicles.

[illegible] A. V. DOWNTON, Erith, Kent.—Improvements in bobbins for stranding machines for the manufacture of wire and other ropes, cables, and the like.

23,763. A. E. DAVY, Donnybrook.—An automatic safety collision appliance for road or rail motors and locomotives.

23,771. R. HYDE AND J. R. HYDE, Sheffield.—Improvements in buffers for railway wagons and similar vehicles.

23,774. S. E. ALLEY AND D. H. SIMPSON, Glasgow.—Improvements in and relating to the valve gear of steam engines.

23,776. E. DIXON, Hull.—Novel or improved type of pumping apparatus.

23,278. H. C. HEIDE, London.—Improvements in signalling systems. (George Martin Seeley, United States.)

23,797. R. [illegible] A. L. H[illegible] R. [illegible]BRIDGE AND J. M. [illegible] Manchester.—Improvements in ejector-condensers.

23,799. W. ROBERTS, H. A. ROBERTS, AND J. ROBERTS (trading as FISHER AND CO.), AND R. H. SCHOFIELD, Liverpool.—Improved non-conducting coverings for boilers, steam pipes and similar uses.

23,816. H. PETERS, London.—Improvements in the mode of effecting certain operations in the manufacture of Portland cement and apparatus for use in the said operations.

23,826. W. H[illegible], London.—Improved [illegible] operating taps, valves, switches, and the like.

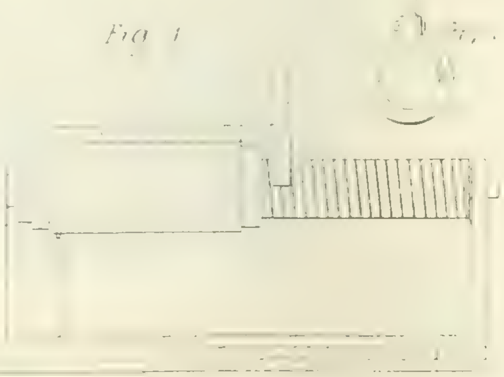
23,829. J. E. L. ODGEN, London.—Improvements in steam traps

RECENT SPECIFICATION.

IMPROVEMENTS IN INSTRUMENTS FOR THE MEASUREMENT OF WAVE LENGTHS IN WIRELESS TELEGRAPHY.

Dr J. A. Fleming, University College [illegible] November 2nd, [illegible]. This invention [illegible] to improvements in kummeters for the measurement of the wave lengths and frequencies employed in Hertzian wave wireless telegraphy. In practical telegraphy of the above kind, the distance to which it is possible to propagate signals over land or sea depends very much upon the nature of the electric wave used, and it is necessary to be able to measure the wave length quickly and directly without disturbing the apparatus employed for sending. Professor Fleming does this by constructing a closed-oscillating circuit consisting of a capacity in the form of a cylindrical sliding condenser and a spiral variable inductance connected together so that one motion reduces or increases both the inductance and capacity at the same time. Since the frequency in an oscillating circuit varies inversely as the square root of the product of capacity and inductance this has the effect that the total alteration of the arrangement varies as the wave length.

The process of measurement is as follows: The aerial wire in which the electric oscillations are created which transmits or creates the sending electric wave is placed for part of its course parallel with and closely touching, but insulated from, the rod or wire which connects the outer ends of the condenser and inductance coil of the kummeter. The capacity and inductance of this latter are then varied together by sliding along the outer cylinder by means of an insulating handle so that this electrical system comes to have a natural free time of oscillations equal to that of the oscillation in the telegraphic transmitter. When this is the case, resonance is established and the vacuum tube lights up or glows, owing to the electric field created round it being very strong. It is possible to so graduate the scale of the kummeter, that the length of the electric wave sent out by the aerial is indicated directly in feet or metres.



APPARATUS FOR THE MEASUREMENT OF HERTZIAN WAVE LENGTHS.

NEW PUBLICATIONS.

"ELEMENTARY PRACTICAL METALLURGY: IRON AND STEEL."

[illegible] Longmans Green and Co. [illegible]

[illegible] aim of this introduction to the metallurgy of iron and steel is to awaken the student's interest in the subject. A great deal more has however been accomplished. As Mr. Longmuir points out, [illegible] has been written on metallurgy has only served to discourage the practical man, who is apt to complain that the matter presented never fits in with the practice—a complaint not wholly destitute of truth. At the outset the author gives a concise sketch of the evolution of metallurgy, then describes the methods of examination, which include chemical analysis, microscopical examination, mechanical tests [illegible] pyrometric observation. A lucid definition is [illegible] of such terms as elasticity, tenacity, ductility [illegible]ibility, and brittleness, and the means adopted to test these various traits are detailed. Refractory materials, are dealt with in the first chapter; a comparison of metallurgical fuels follows, covering [illegible] artificial, liquid, and gaseous combustible [illegible] sufficient is said about the preliminary treatment of iron ores to adequately prepare the way for the following sections, which are devoted to the [illegible] furnace and hot-blast stoves, the work of the [illegible] furnace, and the metallic product of the blast [illegible] The general properties of cast-iron are [illegible] in chapter VII. In considering cast-iron as a whole, remarks the author, the first and most striking feature is the high content of elements present other than iron. The value of the various constituents of cast-iron is estimated and the effect on the metal in which they are present. The Bessemer and open-hearth methods of steel-making are discussed, and succeeded by chapters on re-melting cast-iron, malleable [illegible] wrought-iron and the cementation process, in which it is shown that wrought-iron, heated in contact with carbon, absorbs the latter element and becomes steel. The remaining portion of the book is devoted to steel, and is illustrated by an interesting series of microphotographs. The crucible process, the Bessemer process, the open-hearth process, metallography of the heat treatment of steel, and the metallography of hardened steels, all receive careful attention, the author embodying in his work many of the results of the researches of Professor S. O. Arnold [illegible] Mr. A. McWilliam. Altogether the volume is an [illegible]ent one, and the student who has made a thorough [illegible] of Mr. Longmuir's work will have gained a sound [illegible] principles of the [illegible] of [illegible]

BOOKS RECEIVED.

[illegible] Chain for Lifting and Hauling [illegible] Mechanical Engineers' Society. By [illegible] M.I.Mech.E. Published by the Author, [illegible]

[illegible] Civil and Mechanical Engineers' Society [illegible] A. S. E. Ackermann [illegible] Published by the Society, 25, Victoria Street.

"Handbook of Metallurgy." By Dr. Carl Schnabel. Translated [illegible] Macmillan [illegible]

[illegible] By [illegible] Ward [illegible]

NEW CATALOGUES.

The Valor Company, Ltd., Birmingham.—Our readers will doubtless remember the description published in these colums some time ago, of some tests made with the "New Era" Fire Extinguisher. We have just received from the Company the latest lists describing this handy appliance, which is carefully tested to a pressure of 350 lb. to the square inch, and, if necessary, throws a stream of fire-extinguishing chemical from 40 to 50 ft. A most important characteristic is that it will promptly extinguish burning petrol, motor spirit, alcohol, turpentine, oil, tar, and other inflammable material that cannot be dealt with by water. The method of using the extinguisher is simple, it being only necessary to turn the bottom end up and bump the plunger on the floor. The plunger perforates the mica disc of a bottle containing the acid, and the alkali water coming into contact with the acid forms the fire-extinguishing chemical, which at once escapes through the hose, and when thrown on the base of the fire destroys the oxygen and extinguishes the flame. A very interesting application of this invention is an extinguisher designed for motor boats, and carried on brackets affixed to the side of the boat or in any other convenient position.

Alfred Herbert, Limited, Coventry.—The [illegible] new milling machine catalogue gives a great deal of general information for workshop use, and is admirably printed and illustrated. Pages 2, 3, and 4, are concerned with general information on the use of milling machines, while at the end are given details of special milling operations. The accompanying pages are devoted to a record of milling operations, the installation and use of milling machines, preparing work for milling, and milling cutters. A number of new sizes of milling machines are illustrated, including Nos. 3, 6, 9, and 12, horizontal milling machines with patent dial feed motion, arranged to be driven either from spindle or countershaft, and Nos. 1, 3, 5, and 8, vertical milling machines. The horizontal machines possess a number of new features. All hand wheels for operating the tables are placed at the front so that the whole machine can be operated without the workman having to change any handles. The knees are of box form, and are much stronger and more rigid than on such machines as usually made. The elevating screws are telescopic and all movements have graduated micrometer discs. The vertical machines have practically the same features as the horizontals, so far as regards handiness and ease of operation, and are fully described. An important matter in connection with the use of milling machines is the provision of a suitable set of cutters at the outset, so as to enable a new machine to be got to work without delay, and on this account a standard set of tools suitable for general purpose milling is specified for each size of machine.

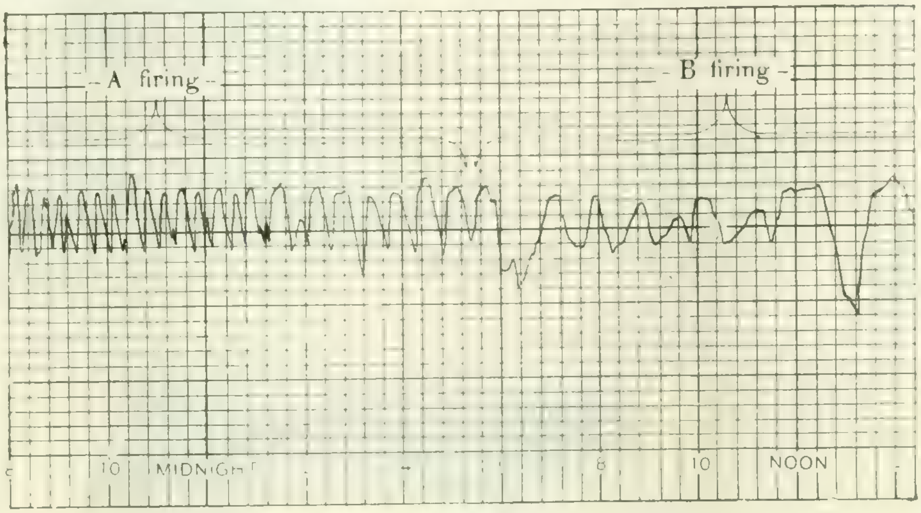
RECEIVED.

☞ Other catalogues and pamphlets include Pamphlet No. [illegible] Arc Lamps from the British Thomson-Houston Company [illegible] Belts [illegible] and Conveying Belts, by Frank Reddaway (F. Reddaway and Co., Ltd., Manchester); Electro-Medical Apparatus, by the General Electric Company [illegible] Sliding [illegible] from Jarvis Bros., Ltd., Middlesbrough.

Pyrometry in Iron and Steel Works.

ANNEALING.

Only very old-fashioned Firms run their Annealing Furnaces without the control of a Thermometer. The annexed Illustration shows a record absolutely observed in go-ahead Works by means of an Electrical Thermometer and Callendar Recorder.



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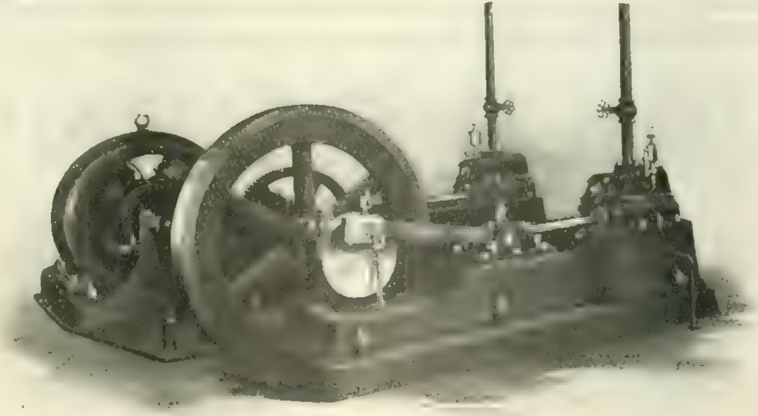

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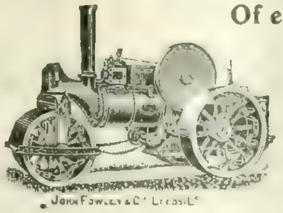
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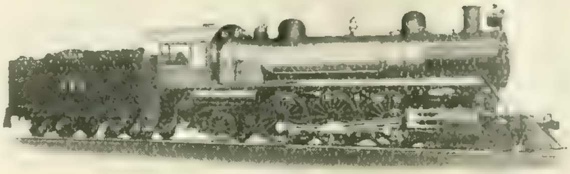

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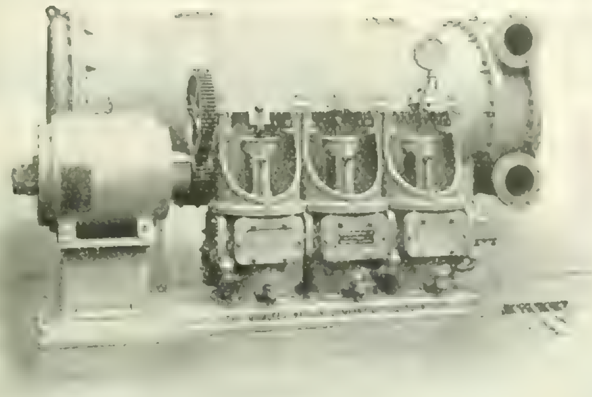

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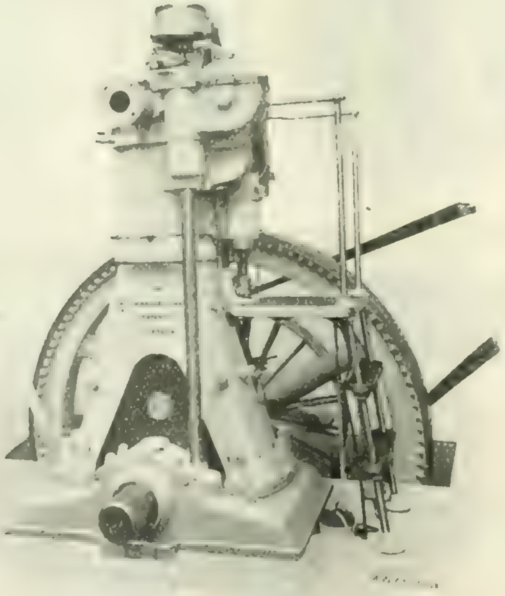

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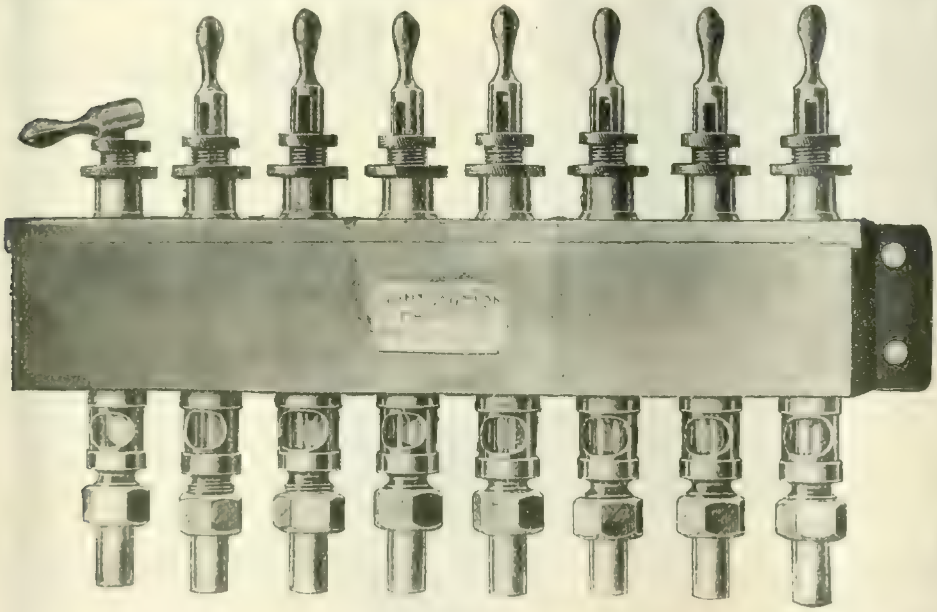

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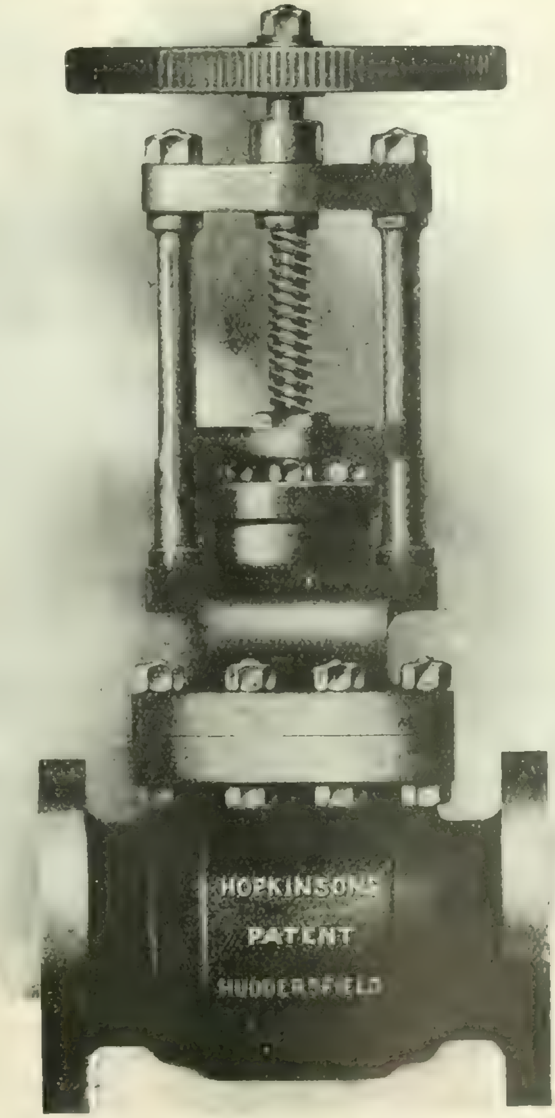

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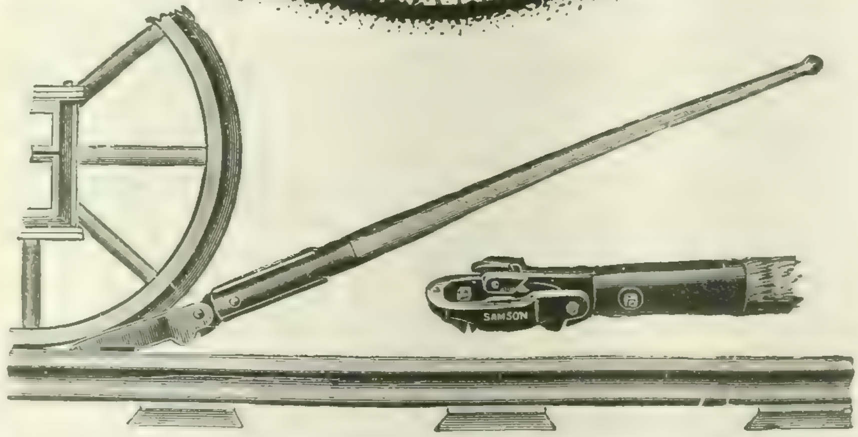

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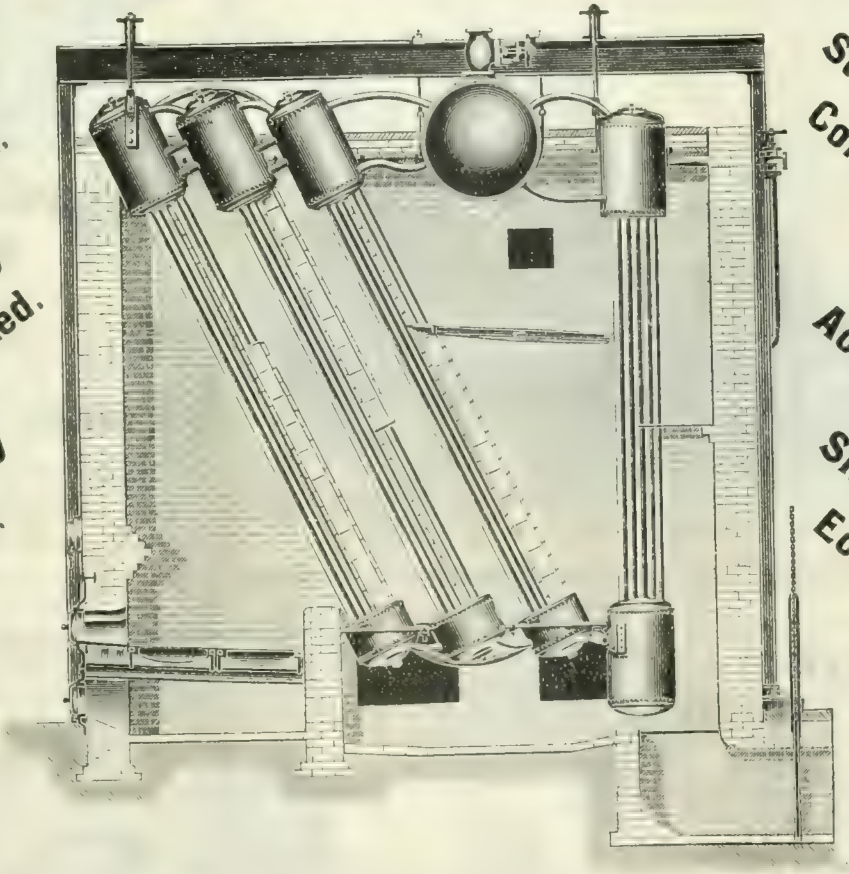

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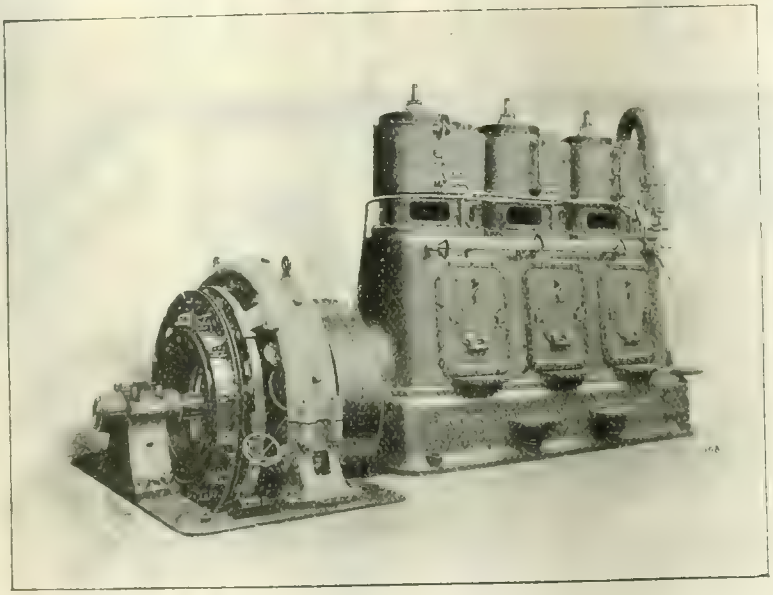

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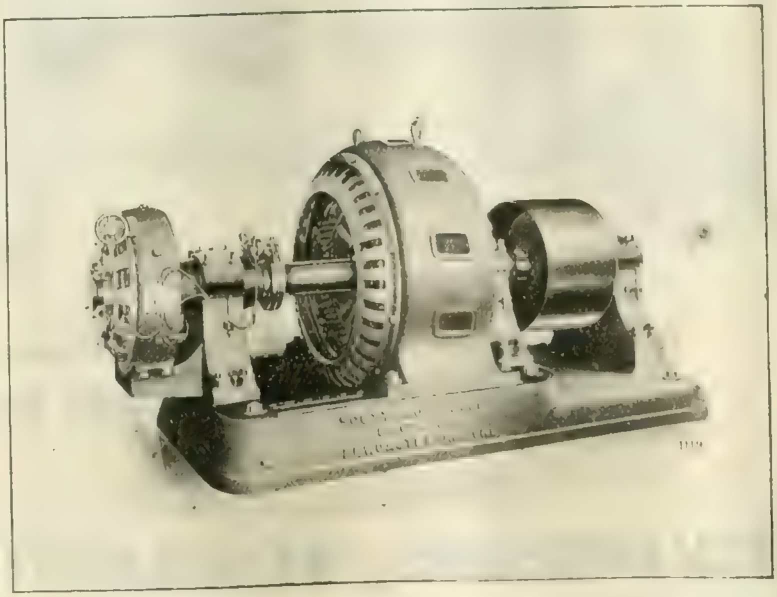

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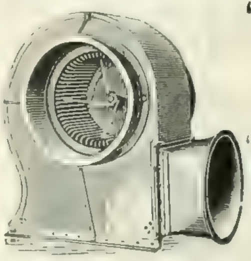

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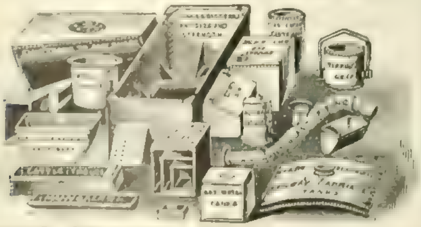

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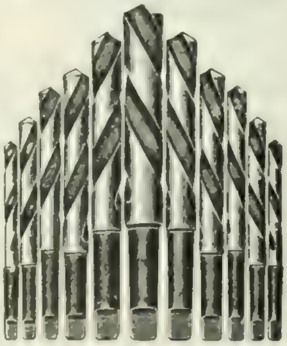

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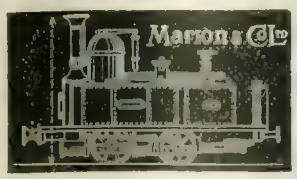
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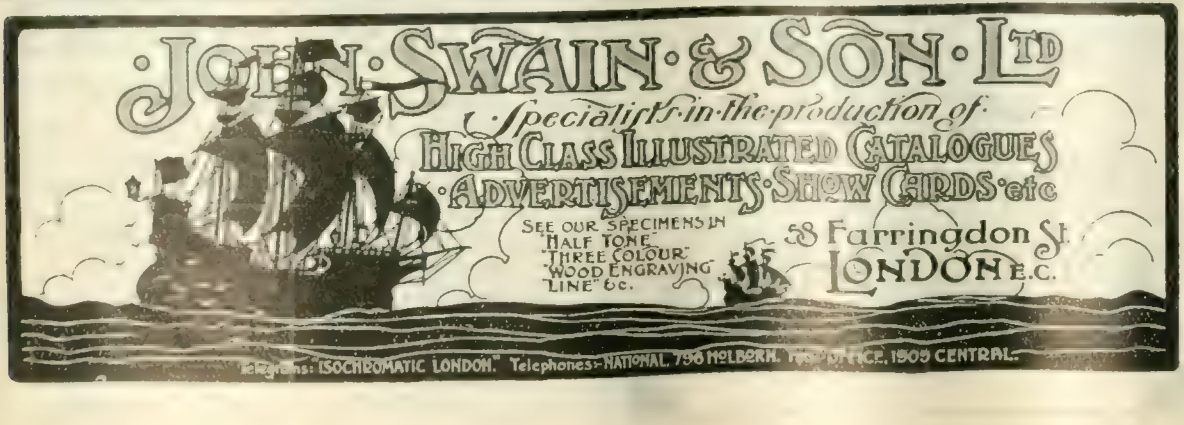

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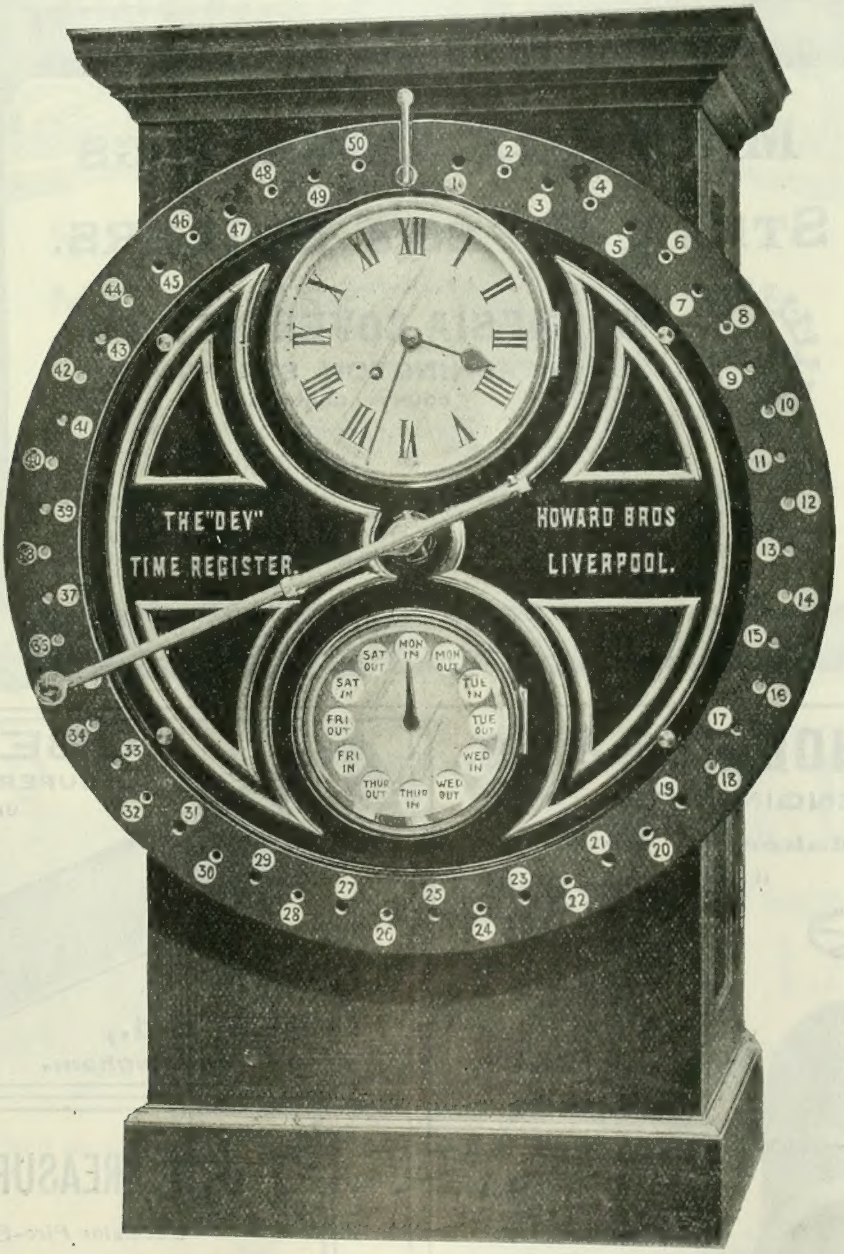

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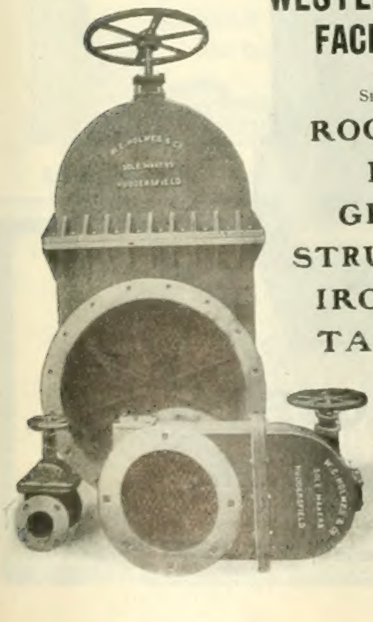

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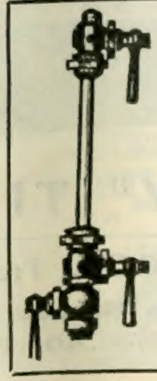

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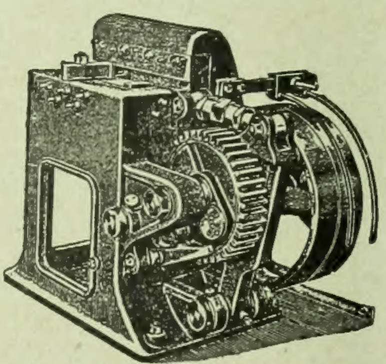

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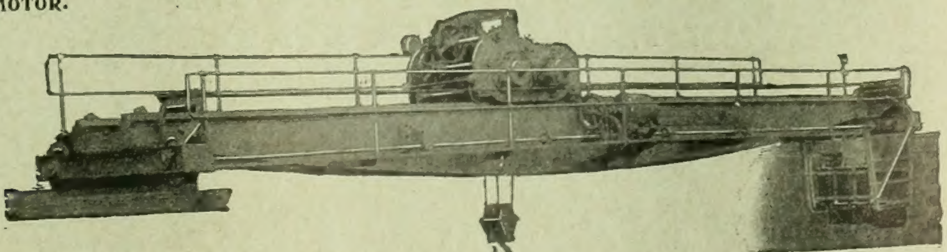

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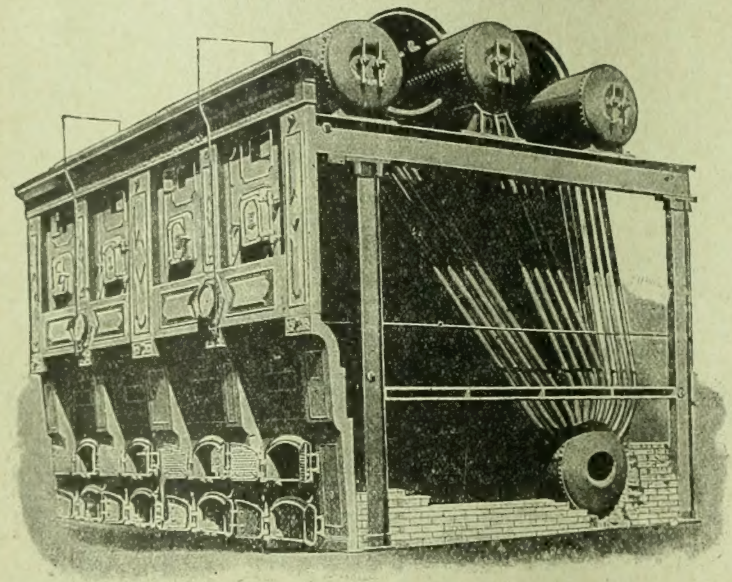

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